

# PROJECT MANUAL

## Primary School Classroom Addition Hallsville R-IV School District Hallsville, Missouri

**NOT FOR CONSTRUCTION**

**A/E Project No. 24-5017**

**Klingner & Associates, P.C.  
3622 Endeavor Ave, Suite 117  
Columbia, MO 65201  
(573) 355-5988**

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**SECTION 000103**  
**PROJECT DIRECTORY**

**OWNER:** **HALLSVILLE R-IV SCHOOL DISTRICT**  
421 East Highway 124  
Hallsville, MO 65255  
Tyler Walker, Superintendent  
(573) 696-5512

**PROJECT MANAGER /  
MEP ENGINEER:** **KLINGNER & ASSOCIATES, P.C.**  
3622 Endeavor Ave, Suite 117  
Columbia, MO 65201  
Matthew Bridges, PE, Project Manager  
(573) 355-5988

**ARCHITECT:** **KLINGNER & ASSOCIATES, P.C.**  
616 N. 24<sup>th</sup> Street  
Quincy, IL 62301  
H. Michael Carter, AIA  
(217) 223-3670

**CIVIL ENGINEER:** **KLINGNER & ASSOCIATES, P.C.**  
616 N. 24<sup>th</sup> Street  
Quincy, IL 62301  
Curt S. Wavering, PE  
(217) 223-3670

**LANDSCAPE ARCHITECT:** **KLINGNER & ASSOCIATES, P.C.**  
616 N. 24<sup>th</sup> Street  
Quincy, IL 62301  
D. Cullan Duke, LA  
(217) 223-3670

**STRUCTURAL ENGINEER:** **KLINGNER & ASSOCIATES, P.C.**  
3622 Endeavor Ave, Suite 117  
Columbia, MO 65201  
Joseph Kirby, PE  
(573) 355-5988

**CONSTRUCTION MANAGER:** **S. M. WILSON & CO.**  
2185 Hampton Ave.  
St. Louis, MO 63139  
Patrick Aylesworth, Project Manager  
314-633-9689

END OF SECTION 000103

**SECTION 000107**  
**SEALS PAGE**

1.1 DESIGN PROFESSIONALS OF RECORD

A. Project Engineer and MEP Engineer:

1. **Matthew H. Bridges**
2. 2021031578.
3. Responsible for Division 21, 23, 26 and 28

B. Architect:

1. **H. Michael Carter**
2. A-6846.
3. Responsible for Divisions 04, 05, 06, 07, 08, 09, 10, and 12

C. Structural Engineer:

1. **Joseph E. Kirby**
2. 2016001264.
3. Responsible for Divisions 03 and 05

END OF SECTION 000107

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END OF SECTION 000110

**SECTION 042000  
UNIT MASONRY**

***Modified to incorporate Addendum #3***

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes unit masonry assemblies consisting of the following:
  - 1. Concrete masonry units (CMUs).
  - 2. Decorative concrete masonry units.
  - 3. Face Brick
  
- B. Related Sections:
  - 1. See 044300 Cast Stone for precast sills.
  
- C. Products installed but not furnished in this Section include:
  - 1. See Division 05 Section "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.

**1.2 SUBMITTALS**

- A. Product Data: For each type of product indicated.
  
- B. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement.
  
- C. Samples for each type and color of exposed masonry units.
  
- D. Material Certificates: For each type of product indicated. Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards.
  - 1. For masonry units include material test reports substantiating compliance with requirements.
  
- E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

**1.3 QUALITY ASSURANCE**

- A. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

- B. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects.
  - 1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high.

#### 1.4 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- C. Store masonry units above ground on level platforms which allow air circulation under the stacked units.
- D. Cover and protect against wetting prior to use.
- E. All masonry units shall be delivered to mason undamaged. Cracked or broken, block with spalled edges or corner, or otherwise defective block shall be rejected by contractor upon delivery and shall not be used in the work.

## PART 2 - PRODUCTS

### 2.1 COLORS, TEXTURES, AND PATTERNS

- A. Exposed Masonry Units: Intent is to match existing.

### 2.2 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions. Provide bullnose units at all exposed outside CMU wall corners.
- B. Integral Water Repellent: Provide units made with liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength for exposed exterior units.
  - 1. Products:
    - a. Addiment Incorporated; Block Plus W-10.
    - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block.
    - c. Master Builders, Inc.; Rheopel.
- C. Concrete Masonry Units: ASTM C 90 UBC Standard 21-4.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.

2. Weight Classification: Lightweight, Medium Weight, or Normal Weight.
3. Pattern and Texture for Decorative Units:
  - a. Standard pattern, split-face finish.
    1. Maximum of one color split-face CMU, match existing.
  - b. Standard pattern, ground-face finish.
    1. Maximum of one color ground-face CMU, match existing.

## 2.3 CONCRETE AND MASONRY LINTELS

- A. Masonry Lintels: Made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout.

## 2.4 BRICK

- A. General: Maximum of one color, match existing brick as closely as possible. Provide shapes indicated and as follows:
  1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: ASTM C 216, Grade MW or SW, Type FBS.
  1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi.
  2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
  3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
  4. Size (Actual Dimensions): 3-5/8 inches wide by 3-5/8 inches high by 11-5/8 inches long.

## 2.5 MORTAR AND GROUT MATERIALS

- A. Portland cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
- B. Hydrated Lime: ASTM C 207 Type S.
- C. Masonry Cement: ASTM C 91.
  1. Products:
    - a. Capital Materials Corporation; Flamingo Color Masonry Cement.
    - b. Essroc, Italcementi Group; Brixment.
    - c. Holcim (US) Inc.; Rainbow Mortamix Custom Buff Masonry Cement.

- D. Aggregate for Mortar: ASTM C 144.
  - 1. For joints less than ¼ inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- E. Aggregate for Grout: ASTM C 404.
- F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
  - 1. Products:
    - a. Addiment Incorporated; Mortar Kick.
    - b. Euclid Chemical Company (The); Accelguard 80.
    - c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
    - d. Sonneborn, Div. of ChemRex; Trimix-NCA.
- G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with split-face concrete masonry units, containing integral water repellent by same manufacturer.
  - 1. Products:
    - a. Addiment Incorporated; Mortar Tite.
    - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
    - c. Master Builders, Inc.; Color Cure Mortar Admix.
- H. Water: Potable.

2.6 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement: ASTM A 951; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.
- C. Single wythe wall horizontal reinforcing: truss and/or ladder type; plain steel; galvanized finish 3/16 inch side rods with 3/16 inch cross ties.
  - 1. Ladder type reinforcing:
 

	Manufacturer	Description	Catalog No.
a.	AA Wire Products Co.	Blok-Lok	AA500
b.	Hohmann & Barnard, Inc.	Ladder-Mesh	#120
c.	Dur-O-Wall, Inc.	Ladur Type	
  - 2. Truss type reinforcing:
 

	Manufacturer	Description	Catalog No.
a.	AA Wire Products Co.	Blok-Lok	AA600
b.	Hohmann & Barnard, Inc.	Truss-Mesh	#120
c.	Dur-O-Wall, Inc.	Truss	

D. Multiple wythe wall horizontal reinforcing:

1. Tri-rod; truss and/or ladder type; plain steel; galvanized finish; 3/16 inch side rods with 3/16 inch cross ties.

a. Ladder Type reinforcing:

	Manufacturer	Description	Catalog No.
1)	AA Wire Products	Blok-Lok Tri-Lok	AA500 AA510
2)	Hohmann & Barnard, Inc.	Ladder Mesh Ladder-Tri-Mesh	#220 #230
3)	Dur-O-Wall, Inc.	Ladur Type Ladur Type Trirod	

b. Truss Type Reinforcing:

	Manufacturer	Description	Catalog No.
1)	AA Wire Products Co.	Blok-Lok 3 Wire Blok Truss	AA600 AA610
2)	Hohmann & Barnard, Inc.	Truss Mesh Truss-Tri-Mesh	#120 #130
3)	Dur-O-Wall, Inc.	Truss	

2. Truss and/or Ladder type reinforcing with U-shaped anchors welded every 16 inches on center and extending into the cavity of the two wythe wall; plain steel; galvanized finish; 3/16 inch side rods with 3/16 inch cross ties and 3/16 inch anchors; complete with 3/16 inch rectangular hooked box tie.

a. Ladder type reinforcing:

	Manufacturer	Description	Catalog No.
1)	AA Wire Products Co.	Econo-Lok	AA550
2)	Hohmann & Barnard, Inc.	Ladder Box Mesh	#260
3)	Masonry Reinforcing Corp. Of America	Adj. Ladder Tab	WB600

b. Truss type reinforcing:

	Manufacturer	Description	Catalog No.
1)	AA Wire Products Co.	Econo-Blok Truss	AA650
2)	Hohmann & Barnard, Inc.	Truss Box Mesh	#160
3)	Masonry Reinforcing Corp. Of America	Adj. Ladder Tab	WB700

E. Cavity backup wall horizontal reinforcing:

1. Truss and/or Ladder type reinforcing with U-shaped extending into the cavity of the two wythe wall; plain steel; hot dip galvanized, after fabrication, finish; 3/16 inch side rods with cross ties and 3/16 inch anchors; complete with 3/16 inch rectangular hooded box tie. The u-shaped anchor shall have a restraint bar and other device attached to it to prevent transverse movement of the two wythes.

a. Ladder type reinforcing:

	Manufacturer	Description	Catalog No.
1)	AA Wire Products Co.	Econo-Cavity Lok II	AA580
2)	Hohmann & Barnard, Inc.	Ladder Box Mesh	#265
3)	Masonry Reinforcing Corp. Of America	Adj. Ladder Tab	WB600-C

b. Truss type reinforcing:

	Manufacturer	Description	Catalog No.
1)	AA Wire Products Co.	Econo-Cavity Blok-Truss	AA680
2)	Hohmann & Barnard, Inc.	Truss Box Mesh	#165
3)	Masonry Reinforcing Corp. Of America	Adj. Ladder Tab	WB700-C

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with Division 07 Section "Sheet Metal Flashing and Trim."

1. Metal Drip Edges: Fabricate from 26 gauge stainless steel. Extend at least 3 inches into wall and ½ inch out from wall, with outer edge bent down 30 degrees and hemmed.
2. Metal Flashing Terminations: Fabricate from 26 gauge stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for ¾ inch and down into joint ¾ inch to form a stop for retaining sealant backer rod.
3. Metal Expansion-Joint Strips: Fabricate from 26 gauge stainless steel to shapes indicated.

B. Flexible Flashing: For flashing not exposed to the exterior, use the following, unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. copper sheet bonded with asphalt between 2 layers of glass-fiber cloth.

a. Products:

- 1) AFCO Products Inc.; Copper Fabric.
- 2) Polytite Manufacturing Corp.; Copper Fabric Flashing.
- 3) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
- 4) York Manufacturing, Inc.; York Copper Fabric Flashing.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Division 07 Section "Sheet Metal Flashing and Trim."

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene.

- B. Preformed Control-Joint Gaskets: Made from [styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805] [or] and designed to fit standard sash block and to maintain lateral stability in masonry wall.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use the following, unless otherwise indicated:
  - 1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth  $\frac{1}{8}$  inch less than depth of outer wythe; in color selected from manufacturer's standard.
    - a. Products:
      - 1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 1. Provide one of the following configurations:
    - a. Strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep.
    - b. Strips, not less than  $1\frac{1}{2}$  inches thick and 10 inches wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
    - c. Sheets or strips full depth of cavity and installed to full height of cavity.
  - 2. Products:
    - a. Advanced Building Products Inc.; Mortar Break.
    - b. Archovations, Inc.; CavClear Masonry Mat.
    - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
    - d. Mortar Net USA, Ltd.; Mortar Net.
- F. **FLUID-APPLIED AIR & WATER BARRIER**
  - 1. *Provide vapor permeable, fluid-applied air and water barriers in cavity walls as detailed on drawings.*
  - 2. *Acceptable manufacturer's:*
    - a. *Tyvek Fluid Applied WB+, Prosoco R-Guard VB, or approved equal. Install according to manufacturer's recommendations.*

## 2.9 INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type X, closed-cell product extruded with an integral skin.

## 2.10 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains from new masonry without damaging masonry. Use product approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
1. Manufacturers:
    - a. Diedrich Technologies, Inc.
    - b. EaCo Chem, Inc.
    - c. ProSoCo, Inc.

## 2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
  2. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement and lime.
  3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification.
1. For masonry below grade or in contact with earth, use Type M.
  2. For reinforced masonry, use Type S.
  3. For mortar parge coats, use Type S.
  4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S.
  5. For interior non-load-bearing partitions, Type N may be used instead of Type S.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- D. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
  - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than  $\frac{1}{8}$  inch in 10 feet,  $\frac{1}{4}$  inch in 20 feet, or  $\frac{1}{2}$  inch maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than  $\frac{1}{8}$  inch in 10 feet,  $\frac{1}{4}$  inch in 20 feet, or  $\frac{1}{2}$  inch maximum.

### 3.2 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- E. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

### 3.3 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick and concrete masonry units as follows:
  - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

### 3.4 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
1. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
    - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
    - b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
    - c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
- B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- C. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit insulation between wall ties and other confining obstructions, with edges butted tightly. Press units firmly against inside wythe of masonry.
- D. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at junction, bond walls together as follows:
1. Provide individual metal ties not more than 16 inches oc.
  2. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.
  3. Provide rigid metal anchors not more than 24 inches oc. If used with hollow masonry units, embed ends in mortar-filled cores.

### 3.5 MASONRY JOINT REINFORCEMENT

- A. General: Install in mortar with a minimum cover of  $\frac{5}{8}$  inch on exterior side of walls,  $\frac{1}{2}$  inch elsewhere. Lap reinforcement a minimum of 6 inches.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

### 3.6 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than ½ inch in width between masonry and structural member, unless otherwise indicated.
2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure, unless otherwise indicated.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

### 3.7 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows, unless otherwise indicated:
  1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing as recommended by flashing manufacturer.
  2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing ½ inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
  4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing ½ inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
- C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
  1. Use specified weep/vent products or open head joints to form weeps holes.
  2. Space weep holes 24 inches o.c., unless otherwise indicated.
- D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.
- E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.
  1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

### 3.8 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  2. Limit height of vertical grout pours to not more than 60 inches.

3.9 FIELD QUALITY CONTROL

- A. Inspectors: Contractor will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
1. Perform the following inspections per Section 1705.4, International Building Code 2015.

1.	From the beginning of masonry construction, the following shall be verified to ensure compliance:
a.	Proportions of site-prepared mortar, grout and prestressing grout for bonded tendons.
b.	Placement of masonry units and construction of mortar joints.
c.	Placement of reinforcement, connectors and prestressing tendons and anchorages.
d.	Grout space prior to grouting.
e.	Placement of grout.
f.	Placement of prestressing grout.
2.	The inspection program shall verify:
a.	Size and location of structural elements.
b.	Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other constructions.
c.	Specified size, grade and type of reinforcement.
d.	Welding of reinforcement.
e.	Protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90° F).
f.	Application and measurement of prestressing force.

3.		Preparation of any required grout specimens, mortar specimens and/or prisms shall be observed.
4.		Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified.

- B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
  - 1. Payment for these services will be made by Owner from Testing and Inspecting Allowance, as authorized by Change Orders.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- D. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- E. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for mortar air content and compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.
- G. Prism Test: For each type of construction provided, per ASTM C 1314, at 7 days and at 28 days.

### 3.10 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
  - 2. Protect adjacent surfaces from contact with cleaner.
  - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
  - 6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

### 3.11 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
  - 2. Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

**SECTION 044300**  
**CAST STONE**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Cast stone masonry.

1.2 RELATED SECTIONS

- A. Section 042000 – Unit Masonry.
- B. Section 079200 – Joint Sealant.

1.3 REFERENCES

- A. ASTM C 150 – Standard Specification for Portland Cement.
- B. ASTM C 1116 – Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
- C. ASTM C 1364 – Standard Specification for Architectural Cast Stone.
- D. Cast Stone Institute Standard Specification ([www.caststone.org](http://www.caststone.org)).

1.4 DEFINITIONS

- A. Cast Stone: Highly refined architectural concrete stone product manufactured to simulate fine grain texture of natural stone.
- B. Vibrant Dry Tamp (VDT) Casting Method: Vibratory ramming of damp, zero-slump concrete against rigid formwork until it is densely compacted and ready for immediate removal from form.
- C. Machine Casting Method: Proprietary automated VDT method which produces modular cladding units in standard sizes with various finishes.

1.5 SUBMITTALS

- A. Comply with Section 013300 – Submittal Procedures.
- B. Product Data: Submit manufacturer's product data.
- C. Shop Drawings: Submit manufacturer's shop drawings including profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, annotation of components, and their locations in project as indicated on the Drawings.

- D. Shop Tickets: Submit manufacturer's shop tickets including profiles, cross sections, modular unit lengths, reinforcement, exposed faces, and annotation of components proposed for use in project according to cross sections as indicated on the Drawings.
- E. Catalog Cuts: Submit manufacturer's catalog cuts showing page and product numbers of units proposed for use in project.
- F. Verification Samples: Submit pieces of actual cast stone components, 12 inches square, illustrating range of color and texture to be anticipated in components furnished for project.
- G. Test Results: Submit manufacturer's test results of cast stone components made previously by manufacturer using materials from same sources proposed for use in project.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A current producer member of Cast Stone Institute, with a minimum of 10 years of experience in producing cast stone of types required for project.
  - 1. Plant shall have adequate capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the Work.
  - 2. Products previously produced by plant and exposed to weather shall exhibit satisfactory appearance.
- B. Standards: Unless otherwise specified in this section, cast stone shall comply with the following:
  - 1. ASTM C 1364.
  - 2. Cast Stone Institute Standard Specification.
- C. Mock-ups: Provide full-size cast stone components for installation in mock-up of exterior wall. Approved mock-ups will become standard for appearance and workmanship.
  - 1. Mock-ups shall remain as part of the completed Work.
  - 2. Mock-ups shall not remain as part of the completed Work. At Architect's direction, demolish mock-ups and remove debris.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
  - 1. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration.
  - 2. Protect corners from damage.
  - 3. Number each piece individually to match shop drawings and schedules.
- B. Storage:
  - 1. Store cast stone components and installation materials in accordance with manufacturer's instructions.
  - 2. Store cast stone components on pallets with nonstaining, waterproof covers.
  - 3. Ventilate under covers to prevent condensation.
  - 4. Prevent contact with dirt.

- C. Handling: Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.

## 1.8 SCHEDULING

- A. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the Work.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. Continental Cast Stone, Website [www.continentalcaststone.com](http://www.continentalcaststone.com), E-Mail [info@continentalcaststone.com](mailto:info@continentalcaststone.com).

### 2.2 CAST STONE MASONRY

- A. Cast Stone:
  - 1. Casting Method: Vibrant dry tamp or machine cast.
  - 2. Compressive Strength: ASTM C 1364.
  - 3. Absorption, Cold Water: ASTM C 1364.
  - 4. Linear Shrinkage: Cast Stone Institute Standard Specification.
- B. Surface Texture: ASTM C 1364.
- C. Color and Finish:
  - 1. Match Color and Texture of Existing Cut Limestone
- D. Permissible Variation in Color:
  - 1. Total Color Difference: ASTM C 1364, 6 units.
  - 2. Hue Difference: ASTM C 1364, 2 units.

### 2.3 CAST STONE MATERIALS

- A. Portland Cement: ASTM C 150, Type I, white or gray as required to match specified color.
- B. Coarse Aggregate: ASTM C 1364. Granite, quartz, or limestone.
- C. Fine Aggregate: ASTM C 1364. Natural or manufactured sands.
- D. Coloring Pigments: ASTM C 1364. Inorganic iron oxides.
- E. Chemical Admixtures: ASTM C 1364.
- F. Water: Potable.

G. Reinforcement: Where required by ASTM C 1364. Galvanized

H. Fiber Reinforcement: ASTM C 1116, fibrous nylon.

## 2.4 MORTAR MATERIALS

A. Mortar: Cast Stone Institute Standard Specification

## 2.5 ACCESSORIES

A. Anchors: Non-corrosive type, sized for conditions. Hot-dip galvanized steel.

A. Sealants: As specified in Section 079200.

B. Cleaner:

1. Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces.
2. Approved for intended use by cast stone manufacturer and approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

## 2.6 FABRICATION

A. Shapes: Unless otherwise indicated on the Drawings, provide:

1. Suitable wash on exterior sills, copings, projecting courses, and components with exposed top surfaces.
2. Drips on projecting components, wherever possible.

B. Reinforcement:

1. As required to withstand handling and structural stresses.
2. Comply with ASTM C 1364.
3. Minimum of 0.25 percent of cross-sectional area of panels which exceed 24 inches in width.
4. Minimum Reinforcing Cover: Twice diameter of reinforcing bars.
5. Units less than 24 inches in either transverse or longitudinal direction may be unreinforced in that direction if structural conditions allow.

C. Curing:

1. Cure cast stone components with a direct-fired steam generator at a minimum temperature of 105 degrees F for a minimum of 6 hours, within 12 hours of fabrication.
2. Cure cast stone components in presence of carbon monoxide and carbon dioxide to promote carbonation at surface, to minimize efflorescence.

D. Finishing: Remove blemishes from exposed surfaces before packaging for shipment.

E. Manufacturing Tolerances: Manufacture cast stone components within tolerances in accordance with Cast Stone Institute Standard Specification.

2.7 SOURCE QUALITY CONTROL

- A. Sampling and Testing: ASTM C 1364.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine construction to receive cast stone components. Notify Architect/Engineer if construction is not acceptable. Do not begin installation until unacceptable conditions have been corrected.
- B. Visual Inspection:
1. Visually inspect cast stone components for fit and finish in accordance with ASTM C 1364 before installation.
  2. Do not install unacceptable components.

3.2 INSTALLATION

- A. General: Install cast stone components in conjunction with masonry, complying with Section 042000.
- B. Setting:
1. Drench cast stone components with clear, running water immediately before installation.
  2. Do not use pry bars or other equipment in a manner that could damage cast stone components.
  3. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.
  4. Set cast stone components in a full bed of mortar, unless otherwise indicated on the Drawings.
  5. Fill vertical joints with mortar.
  6. Make joints 3/8 inch, unless otherwise indicated on the Drawings.
  7. Leave head joints in copings and similar components open for sealant.
  8. Rake mortar joints 3/4 inch for pointing.
  9. Sponge face of each stone to remove excess mortar.
  10. Tuck point joints to a slight concave profile.
- C. Sealant Joints:
1. Comply with Section 079200.
  2. Prime ends of cast stone components, insert properly sized foam backing rod, and install required sealant using sealant gun.
  3. Provide sealant joints at following locations and as indicated on the Drawings.
    - a. Cast stone components with exposed tops.
    - b. Joints at relieving angles.
    - c. Control and expansion joints.

### 3.3 SETTING TOLERANCES

- A. Tolerances: Comply with Cast Stone Institute Standard Specification.
1. Variation from Plumb: Do not exceed 1/8 inch in 5 feet or 1/4 inch in 20 feet or more.
  2. Variation from Level: Do not exceed 1/8 inch in 5 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.
  3. Variation in Joint Width: Do not vary joint width more than 1/8 inch or 1/4 of nominal joint width, whichever is greater.
  4. Variation in Plane Between Adjacent Surfaces: Do not exceed 1/8-inch difference between planes of adjacent components or adjacent surfaces indicated to be flush with components.

### 3.4 REPAIR

- A. Surface Repair:
1. Repair chipping and other surface damage noticeable when viewed in direct daylight at 20 feet.
  2. Repair with matching touchup material provided by manufacturer and in accordance with manufacturer's instructions.
  3. Repair methods and results to be approved by Architect/Engineer.

### 3.5 FIELD QUALITY CONTROL

- A. Inspection and Acceptance: Cast Stone Institute Standard Specification.

### 3.6 CLEANING

- A. In-Progress Cleaning:
1. Clean cast stone components as work progresses.
  2. Remove mortar fins and smears before tooling joints.
- B. Final Cleaning:
1. Clean exposed cast stone, after mortar is thoroughly set and cured.
  2. Cleaner:
    - a. Wet surfaces with water before applying cleaner.
    - b. Apply cleaner to cast stone in accordance with cleaner manufacturer's instructions.
    - c. Remove cleaner promptly by rinsing thoroughly with clear water.

### 3.7 WATER REPELLANT

- A. Apply silane or siloxane water repellent for weatherproofing cast stone in accordance with manufacturer's instructions.
- B. Apply water repellent after pointing, repair, cleaning, inspection, and acceptance are completed.

3.8 PROTECTION

- A. Protect cast stone components from splashing and other damage.

END OF SECTION 044300

**SECTION 053123**  
**STEEL ROOF DECK**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Section Includes:

1. Steel roof deck and accessories.
2. Formed steel cant strips, eave strips, and valley strips.
3. Framing for openings up to and including 18 inches.
4. Bearing plates and angles.

1.2 REFERENCES

A. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Baked Hardenable.

B. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

C. California Department of Health Services:

1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

D. Green Seal:

1. GC-03[-2nd Edition, January 7, 1997] - Anti-Corrosive Paints.

E. Steel Deck Institute:

1. SDI 29 - Design Manual for Composite Decks, Form Decks and Roof Decks.

F. SSPC: The Society for Protective Coatings:

1. SSPC Paint 15 - Steel Joist Shop Paint.

1.3 PERFORMANCE REQUIREMENTS

- A. Design metal deck in accordance with [SDI 29 Design Manual] [and] [ASCE 3].

- B. Calculate to structural working stress design and maximum vertical deck deflection of 1/240.

#### 1.4 SUBMITTALS

- A. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- B. Product Data: Deck profile characteristics and dimensions, structural properties, and finishes.
- C. Manufacturer's installation instructions.
- D. Manufacturer's Certificates: Certify Products meet or exceed specified requirements.
- E. Field Quality Control Submittals: Contractor furnished special structural inspection reports.
- F. Welders Certificates: Certify welders employed on Work, verifying AWS qualification within previous 12 months.

#### 1.5 QUALIFICATIONS

- A. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Store deck on dry wood sleepers; slope for positive drainage.

### **PART 2 - PRODUCTS**

#### 2.1 MATERIALS

- A. Manufacturers:
  - 1. Vulcraft; Nucor Vulcraft Group
  - 2. Verco Decking, Inc.
  - 3. New Millennium Building Systems, LLC
  - 4. ASC Profiles, Inc
  - 5. Canam United States
  - 6. Epic Metals Corporation
  - 7. Roof Deck, Inc
  - 8. Substitutions: Permitted with approval by Engineer.
- B. Sheet Steel: ASTM A653, Grade 33 Structural Quality; with G60 galvanized coating.
- C. Bearing Plates and Angles: ASTM A36 steel
- D. Welding Materials: AWS D1.1.

## 2.2 ACCESSORIES

- A. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to deck.
- B. Acoustical Insulation: Glass fiber type, minimum 1.1 lb/cu ft density; profiled to suit deck.
- C. Sump Pans, Sump Plates, Valley Strips, and Eave Strips: Fabricated of metal of same type and finish as deck.

## 2.3 FABRICATION

- A. Roof Metal Deck: Type B profile structural roof deck configured as follows:
  - 1. Span Design: multiple.
  - 2. Primed painted by manufacture.
  - 3. Minimum Metal Thicknesses Excluding Finish: As indicated on drawings.
  - 4. Nominal Height: As indicated on drawings.
  - 5. Formed Sheet Width: 36 inches
  - 6. Side Joints: interlocking side laps.
- B. Related Deck Accessories: Metal closure strips, cover plates, cant strips, thickness to match deck thickness, galvanized sheet steel; of profile and size as indicated on drawings.
- C. Roof Sump Pan: Fabricate of 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.
- D. Cant Strips: Formed sheet steel, gage thickness to match deck thickness, 45 degree slope, 3-1/2 inch nominal width and height, flange for attachment.
- E. Fasteners: Galvanized hardened steel, self tapping.
- F. Weld Washers: Mild steel, uncoated, 1 inch outside diameter, 16 gage thick.

## 2.4 FINISHES

- A. Shop prime by manufacture.
- B. All exposed structural steel shall be painted per Specification 099100.

## **PART 3 - EXECUTION**

### 3.1 INSTALLATION

- A. Erect metal deck according to SDI Manual.
- B. Bear deck on masonry, concrete, or wood support surfaces with 4 inch minimum bearing. Align and level.
- C. Bear deck on steel supports with 3 inch minimum bearing. Align and level.

- D. Fasten deck to steel support members at ends and intermediate supports with fusion welds through weld washers or mechanical fasteners at 12 inches o.c. maximum, parallel with deck flute and at transverse flute as indicated on the drawings.
- E. Weld according to AWS D1.1.
- F. Fasten male/female side laps at spacing indicated on the drawings
- G. Reinforce steel deck openings from 6 to 18 inches in size with 2 x 2 x 1/4 inch steel angles. Place framing angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld or mechanically attach to deck at each flute.
- H. Install 6 inch minimum wide sheet steel cover plates, of same thickness as deck, where deck changes direction. Fusion weld or mechanically attach at 12 inches o.c. maximum.
- I. Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.
- J. Install single row of foam flute closures above walls and partitions perpendicular to deck flutes.
- K. Position roof sump pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- L. Place metal cant strips in position and fusion weld or mechanically attach.
- M. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up prime paint.

### 3.2 FIELD QUALITY CONTROL

- A. **Owner** shall engage a qualified inspecting agency to perform field special structural inspections in accordance with the applicable International Building Code and to submit reports.
  - 1. Inspect deck size, gage, location and fastening.
  - 2. Inspect welds according to AWS D1.1.
- B. Provide free access to Work and cooperate with appointed agency.
- C. Correct or replace defective decking and connections.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or corrective work.

END OF SECTION 053123

**SECTION 054000**  
**COLD FORMED METAL FRAMING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following:
1. Exterior non-load-bearing wall framing.
  2. Interior non-load-bearing wall framing.

1.2 SUBMITTALS

- A. Product Data: For each type of product and accessory indicated.
- B. Shop Drawings:
1. Indicate component details, framed openings, bearing, anchorage, loading, welds, type and location of fasteners, and accessories or items required of related work.
  2. Describe method for securing studs to tracks and for welded framing connections.

1.3 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code--Sheet Steel."
- C. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

**PART 2 - PRODUCTS**

2.1 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: As required by structural performance.

2. Coating: G60.

## 2.2 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  1. Minimum Base-Metal Thickness: 0.0538 inch (16 gage) minimum.
  2. Flange Width: 1½ inches minimum.
  3. Depth: as shown on drawings.
  4. Section Properties: As required by loads.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and same minimum base-metal thickness as steel studs.
- C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

## 2.3 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  1. Minimum Base-Metal Thickness: 0.0296 inch (22 gage) minimum.
  2. Flange Width: 1¼ inches minimum.
  3. Depth: as shown on drawings.
  4. Spacing: 16 inch on center or as indicated in plans.
  5. Section Properties: As required by loads and indicated in plans.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and same minimum base-metal thickness as steel studs.
- C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

## 2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members, unless otherwise indicated.
- B. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- C. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel headless bolts, with encased end threaded, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- D. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- F. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

## 2.5 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
- C. Install framing members in one-piece lengths.
- D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

- F. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of  $\frac{1}{8}$  inch in 10 feet and as follows:
  - 1. Space individual framing members no more than plus or minus  $\frac{1}{8}$  inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.2 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: 16 inches or as indicated.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single deflection tracks and anchor to building structure.
  - 2. Install double deflection tracks and anchor outer track to building structure.
  - 3. Connect vertical deflection clips to bypassing studs and anchor to primary building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
  - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches - 18 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
    - a. Install solid blocking at centers indicated on Shop Drawings.
  - 2. Bridging: Cold-rolled steel channel welded or mechanically fastened to webs of punched studs.
  - 3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  - 4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

### 3.3 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless top track is connected to the roof deck and is non-load bearing. In this case use deep leg deflection track. Do not fasten studs to deflection track. Space studs as follows:
  - 1. Stud Spacing: 16 inches or as indicated.
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single deflection tracks and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart (unless composite wall with gypsum board installed on both flanges of stud for full height of wall). Fasten at each stud intersection.
  - 1. Top Bridging for Deep Leg Deflection Track: Install row of horizontal bridging within 12 inches of deep leg deflection track.
    - a. Install solid blocking at centers indicated on Shop Drawings.
  - 2. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

### 3.4 FIELD QUALITY CONTROL

- A. **Owner** shall engage a qualified testing and inspecting agency to perform field special structural inspections and testing in accordance with the applicable International Building Code and to submit reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or corrective work.

### 3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, which ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

**SECTION 061000**  
**ROUGH CARPENTRY**

***Modified to incorporate Addendum #3***

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following:
1. Wood blocking and nailers.
  2. Plywood sheathing

1.2 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Wood-preservative-treated wood.

**PART 2 - PRODUCTS**

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
  2. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX)].
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all rough carpentry, unless otherwise indicated:
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood blocking and similar concealed members in contact with masonry or concrete.

### 2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
- B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber with 19 percent maximum moisture content of any species.
- C. Plywood Sheathing:
  - 1. Gymnasium wall bump-outs Sheathing 5/8" thick. Standard B-C Interior Sheathing with Exterior Glue.

### 2.4 WEATHER RESISTANT BARRIER

- A. *ICC AC 38, synthetic house wrap. Refer to place for subsurface to be covered.*

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Comply with AWP A M4 for applying field treatment to cut surfaces of preservative-treated lumber.

### 3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

**SECTION 062000**  
**FINISH CARPENTRY**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Work includes:

1. Provide complete, in place, all finish carpentry required for the project, as shown, detailed, scheduled, or noted on the drawings and as specified herein, including:
  - a. Countertop support brackets
  - b. FRP
2. Work under this Section includes all finish carpentry not specifically included in other sections of the work.

B. Related work

1. Specified elsewhere
  - a. Rough Carpentry specified in Section 061000.
  - b. Painting and finishing specified in Section 099100.
  - c. Manufactured Wood Casework (including all plastic laminate countertops) specified in Section 123200

1.2 SUBMITTALS

- A. Product Data: For panel hardware and accessories, and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- C. Samples: All items requiring finish selection.

1.3 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements of woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- C. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture and required temperature and humidity conditions.

- D. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcement that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. All materials shall be new and as hereinafter specified.

### **2.2 HARDWARE AND ACCESSORIES**

- A. Counter Support Brackets: Provide Richelieu Hardware Workstation Heavy-Duty Brackets with textured powder-coated grey finish.
  - 1. Size to accommodate countertop depth.
- B. Counter Support Cleat: 2"x2"x1/8" Steel Angle Cleat Stock finished to match counter support brackets. Provide by Contractor.

### **2.3 MISCELLANEOUS MATERIALS**

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- D. FRP Wall Panels: Provide Basis-of-Design "Fiber-lite Liner Panels" #LP-F9 as manufactured by Nudo Products, Inc., Springfield, IL, .090 (embossed/pebbled) textured fire-rated, installed over previously installed gypsum board in locations as shown on drawings. Provide all accessories and vinyl moldings as necessary for a complete installation. Provide trim on inside and outside corners. Do not install battens/trim at every butt seam. Acceptable manufacturers: Crane Composites, Structoglass by Ridout Plastics.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF TOPS**

- A. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in

shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

- B. Secure backsplashes and end splashes to walls with adhesive.
- C. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

### 3.2 ADJUSTING AND CLEANING

- A. Repair damaged and defective finish carpentry, where possible, to eliminate functional and visual defects; where not possible to repair, replace.
- B. Clean, lubricate, and adjust hardware.

END OF SECTION 062000

**SECTION 066116**  
**SOLID SURFACING FABRICATIONS – ALT BID #1**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes: Cast plastic fabrications for shower stalls.
- B. Related Requirements:
  - 1. Section 061000 - Rough Carpentry: Framing of shower openings and blocking.
  - 2. Section 079000 - Joint Protection: Perimeter sealant to adjacent construction.
  - 3. Section 224000 - Plumbing Fixtures: Plumbing drains and fixture trim.

1.2 REFERENCE STANDARDS

- A. ASTM International:
  - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SEQUENCING

- A. Sequence Work to permit installation of adjacent affected construction and plumbing rough-in.
- B. Coordinate installation of shower stalls with partition erection and plumbing Work.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate dimensions, thicknesses, required clearances, tolerances, materials, colors, finishes, fabrication details, field jointing, adjacent construction, methods of support, integration of plumbing components, and anchorages.
- C. Samples: Submit two samples representative of shower stall, 2" x 3" in size, illustrating color, texture, and finish.
- D. Manufacturer's Instructions: Submit preparation of opening required, rough-in sizes, tolerances for item placement, temporary bracing of components.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit list of approved cleaning materials and procedures required; list substances harmful to component materials. Include instructions for stain removal, surface and gloss restoration.

1.6 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- B. Perform Work in accordance with specified building codes and manufacture standards.
- C. Maintain one copy of each standard affecting the Work of this Section on-Site.

1.7 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.8 WARRANTY

- A. Furnish manufacturer's warranty for each type of unit.

**PART 2 - PRODUCTS**

2.1 PLASTIC FABRICATIONS

- A. Manufacturer List:
  - 1. Basis of Design Product: Onyx Collection
  - 2. Avonite Surfaces
  - 3. Formica Corp.
  - 4. Swanstone
  - 5. Wilsonart
  - 6. Corian DuPont

2.2 MATERIALS

- A. Resin: polyester type, with integral coloring, stain resistant to domestic chemicals and cleaners.
- B. Adhesive: As recommended by manufacturer.

2.3 FABRICATION

- A. Fabricate components by mold to achieve shape and configuration.
- B. Gel coat exposed finish surfaces smooth and polish to gloss sheen.
- C. Radius corners and edges.
- D. Cure components prior to shipment.

## 2.4 LOW-PROFILE SHOWER KIT

### A. Basis of Design Product: Onyx Collection, Standard Low Profile Shower Kit

1. Base Size: 60 x 36 inches
2. Base Type: Standard Low Profile
3. Drain: Center
4. Wall Panel Height: As indicated on drawings and schedules.
5. Color: As indicated on drawings and schedules.
6. Accessories:
  - a. Adhesive Silicone
  - b. Seamfill Silicone: color to match wall panels
  - c. Add-On Ramp if finished transition is greater than ½”.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Verify floor is firm, structurally sound and level.
- B. Verify that joint preparation and affected dimensions are acceptable.

### 3.2 PREPARATION

- A. Provide anchoring devices for installation and embedding.
- B. Provide templates and rough-in measurements.

### 3.3 INSTALLATION

- A. Align Work plumb and level.
- B. Install shower base flush to ceramic tile finished flooring.
- C. Install according to manufacturer's printed instructions.
- D. Seal to adjacent construction as specified in Section 07 90 00 - Joint Protection.

### 3.4 TOLERANCES

- A. Maximum Variation from Indicated Dimension: 1/8”
- B. Maximum Offset from Indicated Position: 1/8”

### 3.5 CLEANING

- A. Remove excess silicone and adhesive after installation.

- B. Clean and polish fabrication surfaces.
- C. Protect shower base until completion of construction.

END OF SECTION 066116

## SECTION 072100 THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Perimeter insulation under slabs-on-grade.
  - 2. Perimeter wall insulation.
  - 3. Cavity-wall insulation.
  - 4. Sound attenuation insulation
  - 5. Vapor retarders.
  - 6. Foamed In-Place Insulation

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units for each type of exposed insulation indicated.
- C. Product test reports.
- D. Research/Evaluation Reports: For foam-plastic insulation.

#### 1.3 QUALITY ASSURANCE

- A. Retain ASTM test method below based on product and kind of fire-resistance characteristic specified for each product in Part 2. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84 for surface-burning characteristics and other methods indicated with product, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.60 lb/cu. ft., with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
1. Available Manufacturers:
    - a. DiversiFoam Products.
    - b. Dow Chemical Company.
    - c. Owens Corning.
    - d. Pactiv Building Products Division.

## 2.3 GLASS-FIBER BLANKET INSULATION

- A. Available Manufacturers:
1. CertainTeed Corporation.
  2. Johns Manville.
  3. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- C. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:
1. 6-1/4 inches thick (R-19) with a thermal resistance of 21 deg F x h x sq. ft./Btu at 75 deg F.

## 2.4 SLAG-WOOL-FIBER/ROCK-WOOL-FIBER BLANKET INSULATION

- A. Manufacturers:
1. Fibrex Insulations Inc.
  2. Owens Corning.
  3. Thermafiber.
- B. Unfaced, Slag-Wool-Fiber/Rock-Wool-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- C. Where slag-wool-fiber/rock-wool-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt form with thermal resistances indicated:
1. 3-1/2 inches thick with a thermal resistance of 13 deg F x h x sq. ft./Btu at 75 deg F.

## 2.5 VAPOR RETARDERS

- A. Vapor barrier shall have all of the following qualities:

1. Maintain permeance of less than 0.03 Perms [grains/(ft<sup>2</sup> - hr - inHg)] as tested in accordance with mandatory conditioning test per ASTM eq745 Section 7.1 (7.1.1-7.1.5)
  2. Other performance criteria:
    - a. Strength: ASTM E1745 Class A.
    - b. Thickness: 10 mils minimum
  3. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1
- B. Vapor barrier products:
1. Basis-Of-Design: Stego Wrap Class A Vapor Retarder (10-mil) by Stego Industries LLC., (877) 464-7834 [www.stegoindustries.com](http://www.stegoindustries.com), or comparable product by one of the following:
    - a. Raven Industries Inc., DURA – SKRIM.
    - b. Reef Industries Inc., Griffolyn.
  - C. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
  - D. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.
  - E. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.
  - F. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and with demonstrated capability to bond vapor retarders securely to substrates indicated.
- 2.6 FOAMED IN-PLACE INSULATION
- A. Basis-Of-Design: Fomo Products “Hando-Foam” two component low pressure E84 Class 1 spray foam or comparable product by one of the following:
1. Dow Chemical
  2. Certainteed
- B. Materials - spray foam two-component spay cellular plastic foam complying with the following methods and meeting the following physical properties:
1. Core Density: Minimum 2pcf
  2. Thermal Resistance: 140 degree F/ 90 day aged R-Value, measured at 75F mean temp. Minimum R 6.0 per inch.
  3. Flame Spread: ASTM E84, Class A – 20.
  4. Smoke Developed (ASTM E84, Class A) – 400.
  5. Compressed strength minimum (ASTM 1621 D2842: 2.5 percent: perpendicular @ 10% - 16 lb/in<sup>2</sup>; parallel @ 10% - 26 lb/in<sup>2</sup>).
  6. Closed Cell Content (ASTM D2856): minimum 95 percent
  7. Water absorption by volume maximum (ASTM D2842): 2.9 percent.
  8. Water Absorption (ASTM D2842) – 2.9%
  9. Fungi Resistance (ASTM G21) – No Growth

- C. Primers: follow manufacturer's recommendations for surface conditions. For oily surfaces like roof deck, aluminum tube or Z-bar, etching or a primer may be needed before spraying polyurethane foam.

## 2.7 AUXILIARY INSULATING MATERIALS

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturers for sealing joints and penetrations in vapor-retarder facings.
- B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

## 2.8 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate formed from perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square, welded to projecting copper-coated steel spindle 0.105 inch in diameter and of length capable of holding insulation of thickness indicated securely in position with 1-1/2-inch- square or diameter self-locking washers complying with the following requirements:
  - 1. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel sheet, with beveled edge for increased stiffness.
- B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

### 3.2 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
  - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.
- D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

### 3.3 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
  - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
  - 2. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
  - 3. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

### 3.4 INSTALLATION OF VAPOR RETARDERS

- A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated.
- B. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.
- C. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

### 3.5 INSTALLATION OF FOAMED IN-PLACE INSULATION

- A. Examination
  - 1. Verify existing conditions are ready to receive work.
  - 2. Beginning of application implies acceptance of existing conditions.
- B. Preparation
  - 1. Apply required primers for special conditions as recommended by manufacturer.
- C. Application
  - 1. Apply in accordance with ASTM C1029 and manufacturer's installation guidelines.

END OF SECTION 072100

**SECTION 075323**  
**ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING**

**PART 1 - GENERAL**

1.1 SUMMARY

A. This Section includes the following:

1. Adhered membrane roofing system.
2. Roof system accessories
3. Roof insulation.
4. Metal fascia

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for wood nailers and blocking.
2. Division 07 Section "Roof Specialties" for roof edge drainage systems.
3. Division 07 Section "Joint Sealants."

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.

1. Base flashings and membrane terminations.
2. Insulation fasteners and fastening patterns.

C. Samples for Verification: For the following products:

1. 12-by-12-inch square of sheet roofing, of color specified, including T-shaped side and end lap seam.
2. 12-by-12-inch square of roof insulation.
3. 12-inch length of metal termination bars.
4. Six insulation fasteners of each type, length, and finish.

D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of meeting performance requirements.

F. Qualification Data: For Installer and manufacturer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.

- H. Research/Evaluation Reports: For components of membrane roofing system.
- I. Maintenance Data: For roofing system to include in maintenance manuals.
- J. Warranties: Special warranties specified in this Section.
- K. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

### 1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.4 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

### 1.5 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
- B. Manufacturer Qualifications: A qualified manufacturer that has UL listing for membrane roofing system identical to that used for this Project.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain components for membrane roofing system from same manufacturer as roofing membrane.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
  - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

## 1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
  - 1. Special total system warranty with no dollar limitation includes roofing membrane, base flashings, roofing system, accessories, roof insulation, fasteners, substrate board, roof pavers, walkway products, coping system, fascia system and other components of membrane roofing system (including all components specified in this section). Unless otherwise approved by the membrane manufacturer, all products must be manufactured and supplied by the roofing system manufacturer and covered by the warranty.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.2 EPDM ROOFING MEMBRANE

- A. EPDM Roofing Membrane: ASTM D 4637, Type I, nonreinforced uniform, flexible sheet made from EPDM, and as follows:
  - 1. Manufacturers:

- a. Carlisle SynTec Incorporated.
  - b. Firestone Building Products Company.
  - c. Versico Inc.
2. Thickness: 60 mils, nominal.
  3. Exposed Face Color: Black.

## 2.3 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
  1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: 60-mil- thick EPDM, partially cured or cured, according to application.
- C. Bonding Adhesive: Manufacturer's standard bonding adhesive.
- D. Cold Fluid-Applied Membrane Adhesive: Manufacturer's standard cold fluid-applied bonding adhesive formulated to adhere fleece-backed roofing membrane to substrate.
- E. Seaming Material: Single-component butyl splicing adhesive and splice cleaner.
- F. Lap Sealant: Manufacturer's standard single-component sealant, color to match roofing membrane.
- G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- H. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

## 2.4 ROOF INSULATION

- A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.
  1. Manufacturers:
    - a. Carlisle SynTec Incorporated.
    - b. Firestone Building Products Company.
    - c. Versico
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches, unless otherwise indicated.

- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

## 2.5 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.

## 2.6 MANUFACTURED METAL FASCIA SYSTEM

- A. Basis-of-Design Product: Metal-Era "Anchor-tite" fascia or a comparable product by one of the following manufacturers:
  - 1. Hickman, W.P. Company.
  - 2. MM System.
- B. Roof Edging System:
  - 1. Anchor-Tite: Decorative metal fascia with continuous extruded aluminum bar. To terminate adhered or mechanically attached single-ply roofing at perimeter. The system shall be watertight with no exposed fasteners. Model shall be AF-7. The rise above the roof surface for all models is 1-1/4". Fascia model number denotes inches; (i.e. AF-55 has a 5-1/2" face height).
  - 2. Performance Characteristics:
    - a. Extruded bar shall lock membrane, prevent wind pullback.
    - b. Injection molded EPDM splices to allow thermal expansion of extruded aluminum anchor bar.
    - c. Fascia shall freely thermal cycle on extruded bar, preventing periodic maintenance.
    - d. Fascia may be factory modified for true radius application.
  - 3. Fascia metal gauge: .040" thick formed aluminum with Kynar 500 finish.
  - 4. Fascia: standard 12'0" lengths.
  - 5. Extruded bar: Shall be continuous 6063-T6 alloy aluminum at 12'0" standard lengths. All bar miters are welded.
  - 6. Fasteners: #12 x 1 5/8" corrosion resistant fasteners provided with drivers. No exposed fasteners permitted.
  - 7. Exterior fascia finishes: Kynar 500 from manufacturer's standard colors.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
2. Verify that wood blocking and nailers are securely anchored to roof deck at penetrations and terminations and those nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
4. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.3 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
  1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
  1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. and allow primer to dry.

### 3.4 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.
- B. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- E. Cold Fluid-Applied Adhesive: Apply cold fluid-applied adhesive to substrate at rate required by manufacturer and install fleece-backed roofing membrane.
- F. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- G. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- H. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.
  - 1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.
- I. Repair tears, voids, and lapped seams in roofing that does not meet requirements.
- J. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
- K. Install roofing membrane and auxiliary materials to tie in to existing roofing.

### 3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

- E. Terminate and seal top of sheet flashings [and mechanically anchor to substrate through termination bars.

### 3.6 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.7 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
  - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.
- C. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.8 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075323

## SECTION 079200 JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
  - 1. Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 2. Exterior joints in horizontal traffic surfaces.
  - 3. Interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 4. Interior joints in horizontal traffic surfaces.
- B. See Division 32 Section "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.
- C. See Division 08 Section "Glazing" for glazing sealants.

#### 1.2 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Preconstruction field test reports.
- D. Compatibility and adhesion test reports.
- E. Product test reports.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

#### 1.4 QUALITY ASSURANCE

- A. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

- B. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 and in accordance with manufacturer's field adhesion test procedure (see Section 1.5.B); each that is appropriate for the types of Project joints.
- C. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
  - 1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

## 1.5 WARRANTY

- A. Special installer's warranty for sealant installed at exterior side of precast concrete wall panel joints: 5 years period from date of Substantial Completion.
- B. Special manufacturer's warranty for sealant installed exterior side of precast concrete wall panel joints: 20 years from date of Substantial Completion (upon documentation of field adhesion tests as per the manufacturers field adhesion test procedure).
- C. Special Installer's Warranty for other sealants: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 2 years from date of Substantial Completion.
- D. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

### 2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

## 2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- D. Single-Component Neutral and Basic-Curing Silicone Sealant:
  1. Products:
    - a. Dow Corning Corporation; 790.
    - b. Tremco; Spectrem 1.
    - c. Pecora Corporation; 890.
    - d. GE Silicones; SilPruf NB SCS9000 NB.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 100/50.
  4. Use Related to Exposure: NT (nontraffic).
  5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
  6. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.
- E. Single-Component Neutral-Curing Silicone Sealant:
  1. Products:
    - a. Dow Corning Corporation; 799.
    - b. GE Silicones; UltraGlaze SSG4000.
    - c. GE Silicones; UltraGlaze SSG4000AC.
    - d. Tremco; Proglaze SG.
    - e. Tremco; Spectrem 2.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 25.
  4. Use Related to Exposure: NT (nontraffic).
  5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
- F. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:
  1. Products:

- a. Pecora Corporation; 898.
    - b. Tremco; Tremsil 600 White.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 25.
  4. Use Related to Exposure: NT (nontraffic).
  5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
- G. Single-Component Nonsag Urethane Sealant:
1. Products:
    - a. Sika Corporation, Inc.; Sikaflex - 1a.
    - b. Sonneborn, Division of ChemRex Inc.; Ultra.
    - c. Sonneborn, Division of ChemRex Inc.; NP 1.
    - d. Tremco; Vulkem 116.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 25.
  4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
  5. Uses Related to Joint Substrates: M, [G,] A, and, as applicable to joint substrates indicated, O.
- H. Single-Component Pourable Urethane Sealant:
1. Products:
    - a. Sika Corporation, Inc.; Sikaflex - 1CSL.
    - b. Sonneborn, Division of ChemRex Inc.; SL 1.
    - c. Tremco; Vulkem Nova 300 SSL.
  2. Type and Grade: S (single component) and P (pourable).
  3. Class: 50.
  4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
  5. Uses Related to Joint Substrates: M, [G,] A, and, as applicable to joint substrates indicated, O.
- I. Single-Component Pourable Urethane Sealant:
1. Products:
    - a. Bostik Findley; Chem-Calk 950.
    - b. Pecora Corporation; Urexpan NR-201.
    - c. Polymeric Systems Inc.; Flexiprene 952.
    - d. Schnee-Morehead, Inc.; Permathane SM7101.
    - e. Tremco; Tremflex S/L.
    - f. Tremco; Vulkem 45.
  2. Type and Grade: S (single component) and P (pourable).
  3. Class: 25.
  4. Use Related to Exposure: T (traffic).
  5. Uses Related to Joint Substrates: M, [G,] A, and, as applicable to joint substrates indicated, O.

## 2.4 LATEX JOINT SEALANTS

- A. Latex Sealant: Comply with ASTM C 834, Type O P, Grade NF.
- B. Products:
  - 1. Pecora Corporation; AC-20+.
  - 2. Schnee-Morehead, Inc.; SM 8200.
  - 3. Sonneborn, Division of ChemRex Inc.; Sonolac.
  - 4. Tremco; Tremflex 834.

## 2.5 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. Products:
    - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
    - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
    - c. Tremco; Tremco Acoustical Sealant
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
  - 1. Available Products:
    - a. Pecora Corporation; BA-98.
    - b. Tremco; Tremco Acoustical Sealant.

## 2.6 PREFORMED JOINT SEALANTS

- A. Preformed Silicone-Sealant System: Manufacturer's standard system consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.
  - 1. Products:
    - a. Dow Corning Corporation; 123 Silicone Seal.
    - b. GE Silicones; UltraSpan US1100.
    - c. Pecora Corporation; Sil-Span.
    - d. Tremco; Spectrem Ez Seal.
- B. Pre-Compressed Foam Sealants: Manufacturer's standard mildew-resistant, non-migratory, preformed, pre-compressed, open-cell foam sealant that is manufactured from high-density urethane foam impregnated with a nondrying, water-repellent agent. Custom size  $\frac{3}{4}$ " x 2" for precast concrete wall panel joints.
  - 1. Provide following product or equal product that meets specified performance criteria in this section:

a. EMSEAL Joint Systems, Ltd.; Backerseal

2. Pre-compressed sealant shall be pre-formed, pre-compressed, self-expanding, sealant system. Expanding foam to be cellular foam impregnated with a water-based, non-drying, polymer-modified 100% acrylic dispersion.
3. Material shall be capable of movements of +25%, -25% (50% total) of nominal material size.
4. At precast concrete joints, pre-compressed sealant to be installed in two layers as shown on drawings at depth sufficient to allow installation of properly sized backer rod and liquid sealant in front of material.
5. Pre-Compressed foam sealant must be supplied pre-compressed to less than the joint size, packaged in reels or shrink-wrapped lengths (sticks) with a mounting adhesive on one face, for ease of installation.

2.7 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C closed-cell material with a surface skin and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26°F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
    - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
  - 2. Remove laitance and form-release agents from concrete.
    - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### **3.2 INSTALLATION**

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
  
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
  
- G. Installation of Preformed Silicone-Sealant System: Comply with manufacturer's written instructions.
  
- H. Installation of Pre-Compressed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. Install in complete accordance with sealant manufacturer's written instructions. No drilling, or screwing, or fasteners of any type are permitted to anchor the system into the substrate.
  
- I. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior vertical and horizontal non-traffic construction joints in cast-in-place concrete.
  - 1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant.
  - 2. Joint-Sealant Color: Custom color as selected by Architect.
  
- B. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry.
  - 1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant.
  - 2. Joint-Sealant Color: Custom color as selected by Architect.
  
- C. Joint-Sealant Application: Exterior vertical joints between different materials listed above.
  - 1. Joint Sealant: Single-component neutral-curing silicone sealant] [Single-component neutral-curing silicone sealant.
  - 2. Joint-Sealant Color: Custom color as selected by Architect.
  
- D. Joint-Sealant Application: Exterior perimeter joints at frames of doors, windows and louvers.
  - 1. Joint Sealant: Single-component neutral-curing silicone sealant.

2. Joint-Sealant Color: Custom color as selected by Architect.
- E. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.
1. Joint Sealant: Single-component non-sag urethane sealant
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- F. Joint-Sealant Application: Interior perimeter joints of exterior openings.
1. Joint Sealant: Single-component non-sag urethane sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- G. Joint-Sealant Application: Interior ceramic tile expansion, control, contraction, and isolation joints in horizontal traffic surfaces.
1. Joint Sealant: Multicomponent non-sag urethane sealant, Multicomponent pourable urethane sealant or Single-component pourable urethane sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- H. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
1. Joint Sealant: Single-component mildew-resistant neutral-curing silicone sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- I. Joint-Sealant Application: Vertical joints on exposed surfaces of interior walls and partitions.
1. Joint Sealant: Multicomponent non-sag urethane sealant, Single-component non-sag urethane sealant or Latex sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- J. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors and windows.
1. Joint Sealant: Latex sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- K. Joint-Sealant Application: Interior control, expansion, and isolation joints in horizontal traffic surfaces.
1. Joint Sealant: Multicomponent non-sag urethane sealant, Multicomponent pourable urethane sealant or Single-component pourable urethane sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.

END OF SECTION 079200

**SECTION 081113  
HOLLOW METAL DOORS AND FRAMES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
1. Standard hollow metal doors and frames.
  2. ICC 500-2014 Storm Shelter Rated Doors and Frames

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required.
- E. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.3 QUALITY ASSURANCE

- A. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.
- B. ICC 500 Storm Shelter Openings: Provide complete door systems for tornado storm shelters, and other areas of refuge, complying and tested according to FEMA 361, Third Edition (2015), Design and Construction Guidance for Community Safe Rooms; and ICC 500 (2014), ICC/NSSA Standard for the Design and Construction of Storm Shelters.
1. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benchmark; a division of Therma-Tru Corporation.
  2. Ceco Door Products; an Assa Abloy Group company.
  3. Deansteel Manufacturing Company, Inc.

4. Steelcraft; an Allegion company.
5. Windsor Republic Doors.
6. Mesker Doors
7. Curries Manufacturing

## 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS, Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS, Type B.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum [A40] [G60 or A60] metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
  1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I.
- H. Glazing: Division 08 Section "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.

## 2.3 STANDARD HOLLOW METAL DOORS

- A. General: Comply with ANSI/SDI A250.8.
  1. Design: Flush panel.
  2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
    - a. Thermal-Rated (Insulated) Doors: R-value of not less than 12.3 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
  3. Vertical Edges for Single-Acting Doors: Square edge.
  4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
  5. Tolerances: SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Comply with ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).

a. Width: 1-3/4 inches.

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

a. Width: 1-3/4 inches.

b. Undercut: 3/4" undercut on all standard interior doors unless otherwise noted.

D. Hardware Reinforcement: ANSI/SDI A250.6.

## 2.4 HOLLOW METAL DOORS FOR ICC 500 STORM SHELTER RATED OPENINGS

A. General: Provide complete tornado resistant door and frame shelter assemblies constructed to resist the design wind pressures for components and cladding and missile impact loads as described in ICC 500 – 2014, ICC/NSSA Stand for the Design and Construction of Storm Shelters. Only single opening and paired opening doors and their frames constructed to resist calculated design wind pressures and laboratory tested missile impacts are acceptable.

1. Door systems, both single door and paired openings, tested and complying with ICC 500 (2014) and FEMA 361 (2015), Design and Construction Guidance for Community Safe Room and supported by third party test results.

2. Sheets fabricated on exterior opening storm commercial quality hot dipped zinc coated steel complying with ASTM A924 A60. Gages to bin in accordance with manufacturers tested assemblies.

3. Vertical Edges: Vertical edges to have the face sheets jointed by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled lock edge, 1/8" in 2".

4. Top Edge: Reinforce top of doors with a continuous steel channel extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached and welded in place with the web of the channel flush with the face sheet of the door. Plastic or composite channel fillers are not acceptable.

5. Hinge reinforcement: Minimum 7 gage plate 1-1/4"x9".

6. Factory glazed narrow lite view window for exterior doors (4" x 25" or 5" x 20")

B. Manufacturers:

1. Deansteel Manufacturing Company, Inc. – FEMA 361 Series

2. Steelcraft; an Allegion company – Paladin Series.

## 2.5 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped corners.

2. Fabricate frames as face welded unless otherwise indicated.

3. Frames for Level 3 Steel Doors: 0.053-inch thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as face welded unless otherwise indicated.
3. Fabricate knocked-down, drywall slip-on frames for in-place gypsum board partitions.
4. Frames for Level 2 Steel Doors: 0.053-inch thick steel sheet.
5. Frames for Borrowed Lights: Same as adjacent door frame.

D. Hardware Reinforcement: ANSI/SDI A250.6.

## 2.6 FRAMES FOR ICC 500 STORM SHELTER RATED OPENINGS

A. General: Subject to the same compliance standards and requirements as standard hollow metal frames, provide complete tornado resistant door and frame assemblies, for both single doors and paired openings, tested and labeled as complying with ICC 500 and FEMA 361 and supported by third party test results.

1. Fabricate exterior and interior frames from 14 gage hot dipped zinc coated steel complying with ASTM designations A924 A60.
2. Manufacturers: Same as Door Manufacturer.

## 2.7 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
5. FEMA 361 Tornado Safe Room Anchors: Existing Opening type anchors.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

## 2.8 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

## 2.9 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, same material as door face sheet.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, same material as frames.
- D. Terminated Stops: Where indicated, terminate stops 6 inches above finish floor with a [45] [90]-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

## 2.10 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- wide steel.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

## 2.11 FABRICATION

- A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- B. Hollow Metal Doors:
  - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors. Seal joints in top edges of doors against water penetration.
  - 2. Glazed Lites: Factory cut openings in doors.
  - 3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.
- C. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  - 2. Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  - 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  - 5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  - 6. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

- 1) Two anchors per jamb up to 60 inches high.
  - 2) Three anchors per jamb from 60 to 90 inches high.
  - 3) Four anchors per jamb from 90 to 120 inches high.
  - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
- b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
- 1) Three anchors per jamb up to 60 inches high.
  - 2) Four anchors per jamb from 60 to 90 inches high.
  - 3) Five anchors per jamb from 90 to 96 inches high.
  - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
  - 5) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
- c. Compression Type: Not less than two anchors in each jamb.
- d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers.
- a. Single-Door Frames: Three door silencers.
  - b. Double-Door Frames: Two door silencers.
- D. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
  3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
  4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 electrical Sections.
- E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
  2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  4. Provide loose stops and moldings on inside of hollow metal work.
  5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

## 2.12 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: ANSI/SDI A250.10.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

##### **A. Hollow Metal Frames: Comply with ANSI/SDI A250.11.**

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
  - a. At fire-protection-rated openings, install frames according to NFPA 80.
  - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
  - c. Install frames with removable glazing stops located on secure side of opening.
  - d. Install door silencers in frames before grouting.
  - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
  - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
  - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
  - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
  - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

- b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
  - 1. Non-Fire-Rated Standard Steel Doors:
    - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
  - 2. Smoke-Control Doors: Install doors according to NFPA 105.
- C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
  - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

### 3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

**SECTION 084113**  
**ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS – ALT. #5 & 6**  
*Modified to incorporate Addendum #1*

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
1. Exterior punched openings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
- D. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product test reports.
- F. Field quality-control reports.
- G. Maintenance data.
- H. Warranties: Sample of special warranties.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
  2. Dimensional tolerances of building frame and other adjacent construction.
  3. Failure includes the following:
    - a. Deflection exceeding specified limits.
    - b. Framing members transferring stresses, including those caused by structural movements to glazing.
    - c. Loosening or weakening of fasteners, attachments, and other components.
    - d. Failure of operating units.

- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Deflection of Framing Members:
  - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed  $L/175$  of the glass edge length for each individual glazing lite and  $1/175$  of clear span for spans up to 13 feet 6 inches and to  $1/240$  of clear span plus  $1/4$  inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to  $3/4$  inch, whichever is less.
  - 2. Deflection Parallel to Glazing Plane: Limited to  $L/360$  of clear span or  $1/8$  inch, whichever is smaller.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- E. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- F. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: **Basis-of-Design Kawneer Trifab Versaglaze 451T (exterior)**, or subject to compliance with all requirements provide products by one of the following:
1. EFCO Corporation.
  2. TRACO.
  3. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
  4. YKK AP America Inc.
  5. **Manko Series 2450**

### 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209.
  2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
  3. Extruded Structural Pipe and Tubes: ASTM B 429.
  4. Structural Profiles: ASTM B 308/B 308M.
  5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

### 2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally broken
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Center.
  4. 2" x 4-1/2" (exterior)
  5. Shear block or screw spline assembly
  6. Steel reinforcement in vertical mullions where noted on drawings.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
  3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

## 2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

## 2.5 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

## 2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
  4. Physical and thermal isolation of glazing from framing members.
  5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  6. Provisions for field replacement of glazing from interior.
  7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.7 ALUMINUM FINISHES

- A. Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  - 1. Color: Clear.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure nonmovement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
  - 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
  - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
  - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Division 08 Section "Glazing."

END OF SECTION 084113

**SECTION 085113**  
**ALUMINUM WINDOWS**

***Modified to incorporate Addendum #1***

**PART 1 - GENERAL**

1.1 SUMMARY

A. Section Includes:

1. Operating and Fixed Aluminum Window Units
  - a. Fixed/Project-In Hopper Aluminum Windows.
2. Glass and Glazing for Aluminum Windows.
3. Wood Blocking, Shims, Anchors, Clips, and all accessories necessary for a complete installation furnished and installed.
4. All aluminum receptor, trim, panning, and closure pieces
5. Installation labor, tools, equipment, and services necessary for installation of Aluminum Windows.

B. Related Sections:

1. Section 07 62 00 (07620) - Sheet Metal Flashing and Trim
2. Section 07 92 00 (07920) - Joint Sealants
3. Section 08 41 13 (08410) – Aluminum Entrances and Storefront
4. Section 08 80 00 (08800) - Glazing

1.2 REFERENCES

A. Aluminum Association (AA)

1. DAF-45 – “Designation System for Aluminum Finishes”

B. American Architectural Manufacturers Association (AAMA):

1. 101 – “Voluntary Performance Specification for Windows, Skylights and Glass Doors”
2. 611 – “Voluntary Specification for Anodized Architectural Aluminum”
3. 1503 – “Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections”
4. 2400 – “Voluntary Specification for Installation of Windows with a Mounting Flange in Stud Frame Construction”
5. 2604 – “Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels”
6. 2605 – “Voluntary Specification, Performance Requirements and Test Procedures for Superior Performance Organic Coatings on Aluminum Extrusions and Panels”
7. CW-10 – “Care and Handling of Architectural Aluminum from Shop to Site”
8. 904-09 – “Voluntary Specification for Multi-Bar Hinges in Window Applications”

C. American National Standards Institute (ANSI) Publications

1. Z97.1 – “Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings”

D. ASTM International (ASTM) Publications:

1. C1036 – “Standard Specifications for Flat Glass”
2. C1048 – “Standard Specifications for Heat-Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass”
3. E90 – “Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements”
4. E283 – “Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen”
5. E330 – “Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference”
6. E331 – “Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference”
7. E413 – “Classification for Rating Sound Insulation”
8. E547 – “Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential”
9. E774 – “Standard Specification for Sealed Insulating Glass Units”
10. E1886 – “Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials”
11. E1996 - “Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes”
12. F588 - “Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact”

E. Glass Association of North America (GANA):

1. “GANA Glazing Manual”

F. Insulating Glass Certification Council (IGCC)

G. Insulating Glass Manufacturers Alliance (IGMA) Publications:

1. Glazing Guidelines

H. National Fenestration Ratings Council (NFRC)

I. U.S. Consumer Product Safety Commission (CPSC) Publications:

1. 16 CFR Part 1201 “Safety Standard For Architectural Glazing Materials”

J. Window and Door Manufacturers Association (WDMA) Publications:

1. ANSI/AAMA/WDMA 101/I.S.2/NAFS-02 “Voluntary Performance Specification for Windows, Skylights and Glass Doors”
2. AAMA/AAMA/WDMA/CSA 101/I.S.2/A440-05 “Standard/Specification for Windows, Doors and Unit Skylights”

### 1.3 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) – with the following supporting data:
1. Product data for each type of aluminum window specified, including standard construction details, dimensions of individual components, profiles, finishes, hardware, and accessories.
  2. Shop drawings for each type of window specified, including 1/4-inch scale wall elevations, typical unit elevations at 3/4-inch scale details, full size details of typical composite members and the following:
    - a. Panning Details
    - b. Flashing and drainage details.
    - c. Receptor/Mullion details, including reinforcement and stiffeners.
    - d. Joinery details.
  3. Samples: Provide full-size or partial-size sample of window illustrating glazing system, quality of construction and finish.
  4. Product certificates signed by the window manufacturer certifying that window units comply with specified performance requirements.
  5. Submit certified independent laboratory test reports verifying compliance with all test requirements of 1.05 PERFORMANCE REQUIREMENTS as requested by Architect.

### 1.4 DEFINITIONS

- A. Performance grade number, included as part of the AAMA/WDMA/CSA 101/I.S.2/A440-05 product designation code, is actual design pressure in pounds force per square foot used to determine structural test pressure and water test pressure.

### 1.5 PERFORMANCE REQUIREMENTS

- A. Certify that windows have been tested in accordance with American Architectural Manufacturers Association (AAMA/WDMA) Specification for Performance Class specified complying with the following performance standards:
1. AAMA/WDMA/CSA 101/I.S.2/A440-05 Performance Requirements: Provide aluminum windows of the performance class and grade indicated that comply with AAMA/WDMA/CSA 101/I.S.2/A440-05.
    - a. Performance Class: AW-PG70
    - b. Performance Grade: 70
  2. Uniform Structural Properties (ASTM E330): Pressure acting inward and outward. Window to be operable with permanent deformation at a maximum of 1/175 of its span, when tested at a static air pressure difference of the following:
    - a. Class AW-PG70: 105.26 PSF
  3. Water Resistance (ASTM E331 and ASTM E547): No uncontrolled water penetration at test pressure indicated.
    - a. Class AW-PG70: 12.11 PSF

4. Air Leakage (ASTM E283):

- a. Project-In Hopper Windows: Maximum 0.03 CFM per sq./ft. of total exterior surface area, when tested at a static air pressure differential of 6.24 PSF minimum.
- b. Fixed Windows: Maximum 0.01 CFM per sq./ft. when tested at a static air pressure difference of 6.24 PSF minimum.

B. Project Wind Loads:

1. The system shall be designed to withstand the following loads with respect to the plane of the wall:
  - a. Positive pressure of 10 p.s.f. at non corner zones.
  - b. Negative pressure of 10 p.s.f. at non corner zones.
  - c. Negative pressure of 10 p.s.f. at corner zones.

1.6 QUALITY ASSURANCE

A. All window units shall be manufactured by a single source.

1. All windows in any one project must be by the same manufacturer and with comparable frame depth, profile, glazing bite, and installation requirements. Manufacturer must provide a window system that can incorporate all window configurations used on the project.
2. Standards: Requirements for aluminum windows, terminology and standard of performance, and fabrication workmanship are those specified and recommended in AAMA/WDMA/CSA 101/I.S.2/A440-05 and The Aluminum Association (AA).
  - a. All window units shall be labeled as conforming to AAMA/WDMA/CSA 101/I.S.2/A440-05. The label shall state the name of the manufacturer, the approved labeling agency and the product designation as specified in AAMA/WDMA/CSA 101/I.S.2/A440-05.
  - b. All testing shall be conducted using AAMA/WDMA/CSA 101/I.S.2/A440-05 Gateway Performance minimum specified test sizes.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Transportation and Handling: Transport products by methods to avoid product damage, deliver in undamaged condition in manufacturer's unopened containers or packaging. Provide equipment and personnel to handle products by method to prevent soiling or damage. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
- B. Storage and Protection: Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain with temperature and humidity ranges required by manufacturer's instruction.

1.8 WARRANTIES

- A. Aluminum Window Warranty

1. Products: Submit a written warranty, executed by the window manufacturer, for the following:
  - a. Framing and sash components: A period of (1) year from the date of manufacture, against defective materials and workmanship, including substantial non-compliance with applicable specification requirements and industry standards, which results in premature failure of the windows or parts, outside of normal wear.
  - b. Insulated glass units: A period of (5) years from the date of manufacture, against insulated glass seal failure unrelated to glass breakage.
  - c. In the event that windows or components are found defective, manufacturer will repair or provide replacements without charge at manufacturer's option.
  - d. Finish: Refer to Part 2, Section 2.06 "FINISHES" for warranty requirements.
  - e. Warranty for all components must be direct from the manufacturer (non- pass through) and non- prorated for the entire term. Warranty must be assignable to the non-residential owner, and transferable to subsequent owners through its length.
2. Installation: Submit a written warranty, executed by the window installer, for a period of (1) year from the date of substantial completion, against defective materials or workmanship, including substantial non-compliance with applicable specification requirements, which result in premature failure.
  - a. In the event that installation of windows or components is found to be defective, installer will repair or provide replacements without charge at the installer's option.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design Product: Subject to compliance with requirements. Provide the product as listed:

1. Quaker Window Products Company, Inc. (800) 347-0438
  - a. Project-In Hopper Window: "E600 Series"
  - b. Fixed Window: E500 with M-18867 Double Jamb (H)
  - c. Units shall be factory mulled in receptor.

- B. Or a compatible product by one of the following

1. EFCO Corporation
2. Peerless
3. TRACO
4. Warsaw Windows
5. *Manko 3527i Windows*

### 2.2 MATERIALS

- A. Aluminum Members:

1. Extruded aluminum prime billet 6063-T6 alloy for primary components, 6063-T6, or 6061-T6 for structural components, all in accordance with (ASTM B221).

- B. Thermal Break Construction:

1. Frame and sash members shall include a thermal break, applied in the manufacturer's facility, using concealed low-conductance poured-in-place polyurethane in a pre-treated cavity.
2. After proper curing, the aluminum bridge section must be removed to provide a 7/16" minimum separation between interior and exterior metal surfaces.

## 2.3 MANUFACTURED UNITS

- A. Principal window frame members shall have a minimum 0.062" outside wall thickness.
- B. Window frame depth shall be 3 1/4" minimum.
- C. Glazing: Refer to Section 2.05 "GLASS MATERIALS".

## 2.4 COMPONENTS

- A. All fasteners, tools, equipment, and other materials necessary for a complete installation shall be furnished by the Contractor.
  1. Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by the manufacturer to be noncorrosive and compatible with all window members, cladding, trim, hardware, anchors, and other components.
- B. Locking handles, cases, and strikes to be die cast or stainless steel.
- C. Thermoplastic or thermo-set plastic caps, housings, and other components to be injection-molded nylon, extruded PVC, or other suitable compound.
- D. Hardware:
  1. Hinging Hardware:
    - a. Hinges shall be 4-bar arm type in accordance with (AAMA 904-09) for Heavy Commercial and Architectural Grade Windows.
    - b. Hinge bars shall be constructed of stainless steel, with solid brass shoes, and nylon bearing washers at all pivot points.
    - c. Hinges shall include one friction adjuster per each.
    - d. All hinge components shall be concealed while window is in the closed position.
  2. Locking Hardware:
    - a. Locks must hold securely up to 200 lbs. of force per lock for negative air pressure and forced entry resistance.
    - b. Locking cam handles and surface mounted keepers shall be constructed of cast white bronze.
    - c. Locking mechanism shall be sequential, include an interlocking roller head, and multi-point internal latching which distributes closing force equally.
    - d. All cam handles shall be removable, "custodial type".
    - e. Sill Flashing: manufacturer's standard snap-on type, if required as shown on Drawings.
  3. Trim: Manufacturer's standard interior snap trims, type as shown on Drawings.

4. Mullions: Provide mullions and cover plates as shown, matching window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.
- E. Coated Low Emissivity Glass: Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), with coating type and performance characteristics complying with requirements specified below:
  1. Low E Coating: Surface #3 on insulated units.
  2. Approved Manufacturers:
    - a. "ClimaGuard 70/36"; Guardian Industries (248) 340-1800
    - b. Approved Substitution by Architect.
  3. Whole Window U-Value shall be a maximum of 0.36.
- F. Tempered Glass: Condition A (uncoated surfaces), Type (transparent glass, flat), Class 1 (clear), Quality q3, clear, fully tempered safety glass (meet requirements of ANSI Z97.1).
  1. All tempered glass shall conform to ASTM C1048, ANSI Z97.1, and CPSC 16 CFR Part 1201. Tempered glass shall bear permanent monogram indicating tempered quality. Fabrication marks on tempered glass shall be located to be concealed in completed installation.
- G. Windows shall be glazed as follows:
  1. Sound Transmission Class (STC) (ASTM E413): Provide glazing required for conforming to overall STC ratings as specified for aluminum windows.
- H. Insulating Glass: Manufacturer's standard units that comply with specified quality standards and coatings.
  1. Provide preassembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E774 for performance classification indicated as well as with other requirements specified for glass characteristics, air space, sealing system, sealant, space material, and desiccants.
    - a. Total Thickness: 1"
    - b. Thickness of Each Pane: (standard 1/8")
    - c. Air Space Thickness: (standard 3/4")
  2. Exterior Pane of Glass:
    - a. Provide tempered glass where shown on Drawings and as required by local codes and ordinances.
    - b.
  3. Insulated Unit Sealing System:
    - a. The IG edge seal system shall provide very low permeability to water vapor ingress @ <math>0.10 \text{ g H}\_2\text{O}/\text{m}^2 \text{ per 24 hrs}</math> to provide a long IG service life"
    - b. The IG edge seal system shall provide very low Thermal Conductance (or Klin) @ <math>0.25 \text{ W}/\text{m}^\circ \text{ C}</math> based on 1/2" (13mm) spacer, and forces warm-edge

2.5 Finish of Aluminum Components

A. Finish of Aluminum Components

1. Finish of all exposed areas of aluminum windows and components shall be applied in accordance with the appropriate AAMA Voluntary Guide Specification shown below:
  - a. Electrolytically Deposited Anodic Coating, Class 1, Designation AAM12C21A44 conforming to (AAMA 611)
  - b. Finish Warranty Period: 5 years from date of manufacture
  - c. Color Selection: As selected from manufacturer's standard.

2.6 FABRICATION

- A. Fabricate windows allowing for minimum clearances and shim spacing around perimeter of assembly, yet enabling installation.
- B. Rigidly fit joints and corners with heavy-duty corner keys. Accurately fit and secure corners tight. Make corner joints flush, hairline, and weatherproof. Seal corner joints with sealant.
- C. Develop drainage holes with moisture pattern to exterior.
- D. Prepare components to receive anchor devices. Fabricate anchorage items.

**PART 3 - EXECUTION**

3.1 EXAMINATION

1. Verify that building substrates permit installation of windows according to the manufacturer's instructions, approved shop drawings, calculations and contract documents.
2. Do not install windows until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Erection of Aluminum Windows

1. Install windows with skilled tradesmen in exact accordance with approved Shop Drawings, Installation Instructions, Specifications, and in accordance with (AAMA 101/I.S.2./ A440-05).
2. Windows must be installed plumb, square, and level for proper weathering and operation. Jambs must not be "sprung", bowed, or warped during installation.
3. Any uncoated aluminum components of Aluminum Window shall be insulated from direct contact with steel, masonry, concrete, or other dissimilar metals by bituminous paint, zinc chromate primer, nonconductive shims, or other suitable insulating materials.

3.3 ADJUSTING AND CLEANING

- A. After completion of window installation, windows shall be inspected, adjusted, put into working order

and left clean, free of labels, dirt, or other debris. Protection from this point shall be the responsibility of the General Contractor.

END OF SECTION 085113

**SECTION 085653**  
**WIND & IMPACT SECURITY WINDOWS – ALT. #4**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Wind and Impact Aluminum Security Windows.
- B. Related Sections:
  - 1. Section 07 62 00 - Sheet Metal Flashing and Trim
  - 2. Section 07 92 00 - Joint Sealants

1.2 ACTION SUBMITTALS

- A. Refer to Section 01 33 00 Submittal Procedures.
- B. Product Data: For each type of framing and glazing including manufacturer recommended installation instructions.
- C. Shop Drawings: Include plans, elevations, sections, details, attachment to other work.
- D. Samples: For each exposed finish.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Indicating compliance with ICC 500 – 2014 and FEMA P-361-2015 requirements
- B. Qualification Data: For Installer and Testing Agency.
- C. Warranty: Sample of finish warranty

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01 60 00 Product Requirements.

## 1.6 WARRANTY

- A. Finish Warranty: Manufacturer's warranty against deterioration of factory finishes for the period of **5** years from the date of Substantial Completion.
- B. Glass Warranty: Manufacturer's warranty against defects in material and workmanship resulting in edge separation or delamination for a period of 5 years from the date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 FRAMING

- A. Basis of Design: Insulgard TOR-GARD TTH600 Tornado and Hurricane Store Shelter Window System by Insulgard Security Products; Phone 800.624.6315; website [www.insulgard.com](http://www.insulgard.com)
- B. Description
  - 1. Factory fabricated framing constructed from either 6005-T5 or 6105-T5 extruded aluminum with integral weep design to allow water to vent to the exterior along horizontal members. Thermal separation of frame using polyamide strip.
  - 2. Dimensions:
    - a. Head, Jamb, and Sill Members: 2-1/2 inches by 6 inches.
    - b. Mullion and Intermediate Horizontal Members: 3-1/4 inch face
  - 3. Unit to be permanently marked with certification label of the certified testing agency acceptable to the authorities having jurisdiction. Label to include:
    - a. Design Pressure
    - b. Tested Pressure
    - c. Missile Criteria
    - d. ICC-500 (2014) Certification Listing

### 2.2 GLAZING

- A. Glazing Material: Insulating Glass Clad Polycarbonate
  - 1. Wind, Impact and Level 3 Ballistic Resistant: TOR-GARD 30 IG

### 2.3 PERFORMANCE CRITERIA

- A. Indicated areas of this project have been designed for occupancy as a storm shelter. The Work identified in this Section is a component of that security occupancy as follows:
  - 1. Type of Shelter: Tornado
- B. Shelter Design Wind Speeds:
  - 1. Tornado 250 MPH
- C. Debris Hazard
  - 1. FEMA P-361-15 Compliant: Pass missile-impact tests according to FEMA P 361-15 / ICC 500-2014 in accordance with:
    - a. ASTM E1886 - Standard Test Method For Performance Of Exterior Windows, Curtain Walls, Doors And Impact Protective Systems Impacted By Missiles and Exposed To Cyclic Pressure Differentials

- b. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
  2. Tornado: Resists impact of a 15 pound 2 by 4 at 100 MPH for vertical surfaces.
- D. Pressure Testing
1. FEMA P-361 Compliant: Pass static pressure tests and cyclic tests according to FEMA P-361-2015/ICC 500-2014 in accordance with:
    - a. ASTM E330 - Standard Test Method For Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
- E. Ballistic Resistant: Level 3 in accordance with UL 752 – Standard for Bullet-Resisting Equipment.
- F. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. NFRC Model Size: 47-1/4 by 59 inches
  2. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.37 as determined according to NFRC 100.
  3. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.45 as determined according to NFRC 200.
  4. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 60 as determined according to NFRC 500.

## 2.4 FABRICATION

- A. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members

## 2.5 FRAMING FINISH

- A. Factory-applied finish:
  1. Clear Anodic Finish: Architectural Class I, clear coating AA-M10C22A41 Mechanical Finish Chemical Finish: etched, medium matte; 0.70 mils minimum complying with AAMA 611 "Voluntary Specification for Anodized Architectural Aluminum"

## 2.6 ACCESSORIES

- A. Anchors: Fully concealed in accordance with performance requirements
- B. Glazing Gaskets: Manufacturer supplied EPDM gasket utilized as component of the tested assembly.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Verify field dimensions of opening prior to fabrication of windows.

- B. Coordinate structural requirements to ensure proper attachment and support.

### 3.2 INSTALLATION

- A. Install windows in accordance with manufacturer's recommendations and approved shop drawings.
- B. Provide required support and securely fasten and set windows plumb, square, and level without twist or bow.
- C. Apply sealant in accordance with window and sealant manufacturer's recommendations as indicated in installation instructions. Wipe off excess, and leave exposed sealant surfaces clean and smooth

### 3.3 PROTECTION

- A. Clean in strict accordance with manufacturer's recommended cleaning procedures
- B. Clean and protect windows from damage during construction operations, using glazing manufacturer recommended cleaning agents. If damage occurs, remove and replace as required to provide windows in their original, undamaged condition.
  - 1. In addition to breakage, damage includes but is not limited to crazing, cracking, fissures and delamination.

END OF SECTION 085653

**SECTION 087100**  
**DOOR HARDWARE**

***Modified to incorporate Addendum #2***

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes the following:
1. Commercial door hardware.
  2. Cylinders for doors specified in other Sections.
  3. Electrified door hardware.
- B. See Division 08 door sections for astragals and door silencers.

**1.2 SUBMITTALS**

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.
    - f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.
    - h. Warranty information for each product.
  4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of

other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

- C. Shop Drawings: Details of electrified access control hardware indicating the following:
  - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
    - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    - b. Complete (risers, point-to-point) access control system block wiring diagrams.
    - c. Wiring instructions for each electronic component scheduled herein.
  - 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified installer of Windstorm assemblies.
- E. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- F. Informational Submittals:
  - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- G. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

### 1.3 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this

Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

- D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
  2. Plans for existing and future key system expansion.
  3. Requirements for key control storage and software.
  4. Installation of permanent keys, cylinder cores and software.
  5. Address and requirements for delivery of keys.
- G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  3. Review sequence of operation narratives for each unique access controlled opening.
  4. Review and finalize construction schedule and verify availability of materials.
  5. Review the required inspecting, testing, commissioning, and demonstration procedures
- H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.
- I. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
1. Test Pressure: Test at atmospheric pressure.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

#### 1.5 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

#### 1.6 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
  - 1. Seven years for heavy duty cylindrical (bored) locks and latches.
  - 2. Twenty five years for manual surface door closer bodies.
  - 3. Two years for electromechanical door hardware.

1.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

**PART 2 - PRODUCTS**

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations.
- C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HINGES, GENERAL

- A. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- B. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
- a. Two Hinges: For doors with heights up to 60 inches.
  - b. Three Hinges: For doors with heights 61 to 90 inches.
  - c. Four Hinges: For doors with heights 91 to 120 inches.
  - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
- a. Widths up to 3'0": 4-1/2" heavy weight as specified.
  - b. Sizes from 3'1" to 4'0": 5" heavy weight as specified.
- C. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless steel, with stainless-steel pin.
  2. Interior Hinges: Steel, with steel pin.
  3. Hinges for Fire-Rated Assemblies: Steel, with steel pin.
  4. Hinges for ICC 500 Storm Shelter Assemblies: Stainless steel, with stainless-steel pin.
- D. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors and outswinging corridor doors with locks.
- E. Fasteners: Comply with the following:
1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
  2. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors and frames. Finish screw heads to match surface of hinges.

## 2.3 BUTTS AND HINGES

- A. Butts and Hinges: BHMA A156.1.
- B. Template Hinge Dimensions: BHMA A156.7.
- C. Provide extra-heavy duty hinges, unless otherwise noted.
- D. Manufacturers:
  1. Hager Companies.
  2. Ives, an Allegion Company.
  3. McKinney Products Company; an ASSA ABLOY Group company.
  4. Stanley Commercial Hardware; Div. of The Stanley Works.

## 2.4 LOCKS AND LATCHES, GENERAL

- A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- C. Lock Trim:
  1. Levers: ~~Hager—Withnell lever.~~ **BEST Access System #15K Lever.**
  2. Dummy Trim: Match lever lock trim and escutcheons.
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors.
- E. Backset: 2-3/4 inches, unless otherwise indicated.
- F. Strikes: Manufacturer's standard ANSI strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

## 2.5 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
1. Bored Locks: BHMA A156.2.
  2. Mortise Locks: BHMA A156.13.
- B. Bored Locks: BHMA A156.2, Grade 1; Extra-Heavy Duty Series.
1. Manufacturers:
    - a. ~~Hager Companies; 3400 Series Lever.~~ BEST Access Systems 9K Series
    - b. Schlage, an Allegion Company, ND Series
    - c. Corbin Russwin, and Assa Abloy Company, CL3300 Series
- C. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13, **Grade 1**; Series 1000.
1. Manufacturers:
    - a. ~~Hager Companies — 3800 Series with occupancy indicator, BEST Access Systems 40H Series with Visual Indicator~~
    - b. Schlage, an Allegion Company, L Series with occupancy indicator
    - c. Corbin Russwin, an Assa Abloy Company, ML2000 Series with occupancy indicator
- D. Multi-Point Tornado Locks: Multi-point exit devices specifically engineered for out-swinging door applications on storm shelters. Extra heavy duty steel component construction with each of the latching points automatically activated when the device is locked. The multi-point exit device is approved for usage as part of a complete ICC 500 (2014) and FEMA 361 door, frame and hardware assembly.
1. Manufacturers:
    - a. Corbin Russwin Hardware; an ASSA ABLOY Group company – FE5400S Series.
    - b. Stanley Precision – 822 Series.
    - c. Schlage Commercial Lock Division; an Allegion Company – LM 9300 Series

## 2.6 AUXILIARY LOCKS AND LATCHES

- A. Cylindrical Deadlocks: ANSI/BHMA A156.5, Grade 1, cylindrical type deadlocks to fit standard ANSI 161 preparation of 1 3/4" thickness doors. Provide tapered collars to resist vandalism and 1" throw solid steel bolt with hardened steel roller pins. **Deadlocks to be products of the same source manufacturer and keyway as other locksets.**
1. Manufacturers:
    - a. Hager Companies – 3100 Series

## 2.7 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
  - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- B. Standards: Comply with the following:
  - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
  - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
  - 3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
  - 4. Dustproof Strikes: BHMA A156.16.

## 2.8 ELECTROMAGNETIC LOCKS

- A. General: BHMA A156.23; electrically powered, of strength and configuration indicated; with electromagnet attached to frame and armature plate attached to door.
  - 1. Type: Full exterior or full interior, as required by application indicated.
  - 2. Strength Ranking: **1000 lbf.**
- B. Manufacturers:
  - 1. Schlage; an Allegion Company.
  - 2. Securitron Magnalock Corporation; an ASSA ABLOY Group company.
  - 3. Security Door Controls.

## 2.9 EXIT DEVICES

- A. Exit Devices: BHMA A156.3, Grade 1.
- B. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
- C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- E. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- F. ICC 500 Rated Devices: Multi-point exit devices for tornado application, tested and certified to comply with the Federal Emergency Management Agency's publication FEMA 361 – Design and Construction Guidance for Community Safe Rooms and UL-ANSI/ICC 500 for F5 tornado applications. Provide as tested system with door and frame.

- G. Removable Mullions: BHMA A156.3.
  - 1. Removable steel mullions with malleable iron top and bottom retainers and a primed paint finish. Provide keyed removable feature, stabilizers, and mounting brackets as specified in the Hardware Sets.
  - 2. Manufacturer: **Same as exit device manufacturer.**
- H. Dogging: Except on fire rated openings, provide exit devices with keyed dogging device to hold the push bar and latch in a retracted position.
- I. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
  - 1. Operation: Movable.
- J. Outside Trim: Lever, Lever with cylinder, Pull, and Pull with cylinder as indicated on schedule; material and finish to match locksets, unless otherwise indicated.
  - 1. Match design for locksets and latchsets, unless otherwise indicated.
- K. Through Bolts: For exit devices and trim as required.
- L. Manufacturers:
  - 1. Stanley Precision – Apex 2000 Series.
  - 2. Von Duprin; an Allegion Company – 98 Series.
  - 3. Architect approved equal.

## 2.10 CYLINDERS AND KEYING

- A. Standard Lock Cylinders: BHMA A156.5, Grade 1.
- B. Conduct specified “Keying Conference” to define and document keying system instructions and requirements.
- C. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- D. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
  - 1. Acceptable Manufacturers:
    - a. *Hager Companies. BEST Access Systems*
    - b. No Substitution – Match Owner’s Existing System.
- E. Cylinders: Original manufacturer cylinders complying with the following:
  - 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
  - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  - 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.

4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  5. Keyway: Match Facility Standard.
  6. Number of Pins: Six.
- F. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- G. Keying System: Each type of lock and cylinders to be factory keyed.
1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
  2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
  3. Existing System: Key locks to existing system as directed by the Owner.
- H. Key Quantity: Provide the following minimum number of keys:
1. Change Keys per Cylinder: Two (2)
  2. Master Keys (per Master Key Level/Group): Five (5).
  3. Construction Keys (where required): Ten (10).
- I. Construction Keying: Provide construction master keyed cylinders.
- J. Key Registration List (Bitting List):
1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
  2. Provide transcript list in writing or electronic file as directed by the Owner.
- K. Keys: Nickel silver; permanently inscribed with a visual key control number and including the notation "DO NOT DUPLICATE."
- 2.11 KEY CONTROL SYSTEM
- A. Use owner's existing system
- 2.12 OPERATING TRIM
- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
1. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor.
  2. Furnish dust proof strikes for bottom bolts.
  3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
  4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
  5. Materials: Fabricate from brass and steel, unless otherwise indicated.

a. Manufacturers:

- 1) Hager Companies.
- 2) IVES Hardware; an Allegion Company.
- 3) Rockwood Manufacturing Company; an ASSA ABLOY Group company.

B. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
3. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

a. Manufacturers:

- 1) Hager Companies.
- 2) IVES Hardware; an Allegion Company.
- 3) Rockwood Manufacturing; an ASSA ABLOY Group company.

## 2.13 CLOSERS

A. Accessibility Requirements: Comply with the following maximum opening-force requirements:

1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
2. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.

C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

D. Surface Closers: BHMA A156.4, Grade 1. Cast iron closer body; provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

1. Manufacturers:

- a. LCN Closers; an Allegion Company – 4040XP Series.
- b. Norton; an ASSA ABLOY Group Company – 9500 Series.
- c. Stanley Commercial Hardware – QDC 100 Series

E. Electrically-Controlled Door Closer/Holder Magnets: ANSI A156.15, UL 10C, Grade 1. Surface mounted, die cast body. Fail safe, hold until current is interrupted. Coordinate closer device with fire alarm system and storm shelter alarm system.

1. Manufacturers:

- a. LCN Closers; an Allegion Company – SEM 7800 Series.
- b. Rixson; an ASSA ABLOY Group Company – 994M Series.
- c. Architect approved equal.

#### 2.14 PROTECTIVE TRIM UNITS

- A. Size: 1-1/2 inches less than door width on push side and 1/2 inch less than door width on pull side, by height specified in door hardware sets.
- B. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from the following material:
  1. Material: 0.050-inch- thick stainless steel.
  2. Manufacturers:
    - a. Hager Companies.
    - b. IVES Hardware; an Allegion Company.
    - c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

#### 2.15 MECHANICAL STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1.
  1. Provide wall stops for doors unless floor or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
- B. Silencers for Door Frames: BHMA A156.16, Grade 1; neoprene or rubber; fabricated for drilled-in application to frame. Provide (3) for all single interior doors and (2) for all pairs in metal door frames.
- C. Manufacturers:
  1. Hager Companies.
  2. IVES Hardware; an Allegion Company.
  3. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

#### 2.16 DOOR GASKETING

- A. Standard: BHMA A156.22.
- B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
  1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
  2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
  3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

- C. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.
  - 1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- E. Hurricane and Tornado Resistance Compliance: Architectural seals to be U.L. listed for windstorm components where applicable. Provide the appropriate hurricane or tornado resistant products that have been independent third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.
- F. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- G. Gasketing Materials: ASTM D 2000 and AAMA 701/702.
- H. Manufacturers:
  - 1. Hager Companies.
  - 2. National Guard Products.
  - 3. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
  - 4. Zero International; an Allegion Company.

## 2.17 THRESHOLDS

- A. Standard: BHMA A156.21.
- B. Accessibility Requirements: Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
- C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch high.
- D. Refer to plans for opening thresholds required at terminations of athletic gym flooring. Alt. #1 opening to locker room – National Guard #426 Aluminum.
- E. Manufacturers:
  - 1. Hager Companies.
  - 2. National Guard Products.
  - 3. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
  - 4. Zero International; an Allegion Company.

## 2.18 ELECTRONIC ACCESSORIES

- A. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to

exceed the required total draw for the specified electrified hardware and access control equipment.

1. Acceptable Manufacturers:

- a. Corbin Russwin Hardware – 782.
- b. Security Door Controls - 630 Series.
- c. Securitron - BPS Series.
- d. Von Duprin - PS.

B. Key Switches: Key switches furnished standard with stainless steel single gang face plate with a 12/24VDC bi-color LED indicator. Integral backing bracket permits integration with any 1 1/4" or 1 1/2" mortise type cylinder. Key switches available as momentary or maintained action and in narrow face plate options.

1. Acceptable Manufacturers:

- a. Security Door Controls - 800 Series.
- b. Securitron - MK Series.

2.19 FABRICATION

A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

B. Fasteners: Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Comply with NFPA 80 for fasteners of door hardware in fire-rated applications.

2.20 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

#### **3.2 PREPARATION**

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

#### **3.3 INSTALLATION**

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  - 3. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. **The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.**

Door Hardware Set No. 01 – Exterior Gym Entrance Door Pair – ICC 500 Rated

3 pair	Butt Hinge	Ives	5BB1HW	US32D
2	Windstorm Surface Mounted Vertical Rod Fire Device – Lever Function	Von Duprin	WS 9827-L-F	US26D
	Cylinder / Keying			
2	Closer, parallel arm – overhead stop at 95°	Norton	9500 Series	US26D
2	Kick Plate	Rockwood	K1050 4BE CSK	US32D
1	Threshold	National Guard	425E	Aluminum

1 set	Meeting Stile Gasketing	National Guard	115NA	Aluminum
1	Perimeter Gasketing	National Guard	PF180	Black
1	Drip Strip	National Guard	16A	US32D

Notes: \*Provide complete tested ICC 500 Door / Frame / and Hardware System

Door Hardware Set No. 01A – Exterior Gym Entrance Door Pair with Card Reader– ICC 500 Rated

3 pair	Butt Hinge	Ives	5BB1HW	US32D
1	Electric Latch Retraction Windstorm Surface Mounted Vertical Rod Fire Device – Lever Function	Von Duprin	EL WS 9827-L-F	US26D
1	Windstorm Surface Mounted Vertical Rod Fire Device – Lever Function	Von Duprin	WS 9827-L-F	US26D
	Cylinder / Keying			
1	Closer, parallel arm – overhead stop at 95°	Norton	9500 Series	US26D
2	Kick Plate	Rockwood	K1050 4BE CSK	US32D
1	Threshold	National Guard	425E	Aluminum
1 set	Meeting Stile Gasketing	National Guard	115NA	Aluminum
1	Perimeter Gasketing	National Guard	PF180	Black
1	Drip Strip	National Guard	16A	US32D
1	Electric Power Transfer	Von Duprin	EPT-2	SP28
1	Power Supply			
1	Card Reader	See specification section 281300 Access Control		

Notes: \* Coordinate all wiring & conduit with the electrical contractor.

\*Mode of Operation: A valid card presentation at card reader retracts latch on active door for authorized entry. Remote door release from central office retracts latch on active door for authorized entry. Free egress at all times.

Door Hardware Set No. 02 – Exterior Classroom Exit Door Pair – ICC 500 Rated

3 pair	Butt Hinge	Ives	5BB1HW	US32D
1	(Active) Windstorm Surface Mounted Vertical Rod Fire Device – Nightlatch Function	Von Duprin	WS 9827-NL-F	US26D
1	(Inactive) Windstorm Surface Mounted Vertical Rod Fire Device – Exit Only Function	Von Duprin	WS 9827-EO-F	US26D
	Cylinder / Keying			
1	Closer, parallel arm – overhead stop at 95°	Norton	9500 Series	US26D
2	Kick Plate	Rockwood	K1050 4BE CSK	US32D
1	Threshold	National Guard	425E	Aluminum
1 set	Meeting Stile Gasketing	National Guard	115NA	Aluminum
1	Perimeter Gasketing	National Guard	PF180	Black
1	Drip Strip	National Guard	16A	US32D

Notes: \* See electrical sheets for future card access prep

Door Hardware Set No. 03 – Exterior Exit Only Door Pair

3 pair	Butt Hinge	Ives	5BB1HW	US32D
1	(Active) Rim Exit Device – Nightlatch Function	Von Duprin	98-NL	US26D

1	(Inactive) Rim Exit Device – Exit Only Function Cylinder / Keying	Von Duprin	98-EO	US26D
1	Keyed Removable Mullion	Von Duprin	KR 4954	SP28
1	Closer, parallel arm – overhead stop at 95°	Norton	9500 Series	US26D
2	Kick Plate	Rockwood	K1050 4BE CSK	US32D
1	Threshold	National Guard	425E	Aluminum
1 set	Meeting Stile Gasketing	National Guard	115NA	Aluminum
2	Perimeter Gasketing	National Guard	PF180	Black
1	Drip Strip	National Guard	16A	US32D
Notes: *				

Door Hardware Set No. 04 – Interior Vestibule Door Pair

3 pair	Butt Hinge	Ives	5BB1HW	US32D
2	Push Plate	Hager	30S – 4x16	US26D
2	Pull Plate	Hager	31E – 4x16	US26D
2	Closer, parallel arm	Norton	9500 Series	US26D
2	Kick Plate	Rockwood	K1050 4BE CSK	US26D
Notes: *				

Door Hardware Set No. 05 – Interior Storm Shelter Door Pair – ICC 500 Rated

3 pair	Butt Hinge	Ives	5BB1HW	US32D
2	(Active) Surface Mounted Vertical Rod Device – Lever Function Cylinder / Keying	Von Duprin	WS 9827-L-F	US26D
2	Closer, parallel arm	Norton	9500 Series	US26D
2	Magnetic Closer / Holder	LCN	7830 Series	Aluminum
2	Kick Plate	Rockwood	K1050 4BE CSK	US26D
2	Perimeter Gasketing	National Guard	PF180	Black
1	Threshold – Door #111A only	National Guard	(2) 8140/8149	Aluminum
Notes: * Coordinate all wiring & conduit with the electrical contractor. *Provide extension arm on magnetic holder as necessary for door position at wall *Mode of Operation: Magnetic closer/holder device holds door in open position. Door is released on activation of fire alarm.				

Door Hardware Set No. 05A – Interior Storm Shelter Door – ICC 500 Rated

1-1/2 pair	Butt Hinge	Ives	5BB1HW	US32D
1	Surface Mounted Vertical Rod Device – Lever Function Cylinder / Keying	Von Duprin	WS 9827-L-F	US26D
1	Closer, parallel arm	Norton	9500 Series	US26D
1	Magnetic Closer / Holder	LCN	7830 Series	Aluminum
1	Kick Plate	Rockwood	K1050 4BE CSK	US26D
2	Perimeter Gasketing	National Guard	PF180	Black
1	Electromagnetic Lock	Schlage	M400 Series	
1	Key switch			
Notes: * Coordinate all wiring & conduit with the electrical contractor. *Provide extension arm on magnetic holder as necessary for door position at wall *Mode of Operation: Magnetic closer/holder device holds door in open position. Door is released on activation of fire alarm.				

alarm.  
 \*Electromagnetic lock door activated by key switch for after-hours gym use. Electromagnetic lock released on activation of fire alarm.

Door Hardware Set No. 05B – Interior Storm Shelter Door – ICC 500 Rated

1-1/2 pair	Butt Hinge	Ives	5BB1HW	US32D
1	Surface Mounted Vertical Rod Device – Lever Function	Von Duprin	WS 9827-L-F	US26D
	Cylinder / Keying			
1	Closer, parallel arm	Norton	9500 Series	US26D
1	Magnetic Closer / Holder	LCN	7830 Series	Aluminum
2	Perimeter Gasketing	National Guard	PF180	Black
1	Kick Plate	Rockwood	K1050 4BE CSK	US26D

Notes: \* Coordinate all wiring & conduit with the electrical contractor.  
 \*Provide extension arm on magnetic holder as necessary for door position at wall  
 \*Mode of Operation: Magnetic closer/holder device holds door in open position. Door is released on activation of fire alarm.

Door Hardware Set No. 06 – Multi-Point Lever Set – ICC 500 Rated

1-1/2 pair	Butt Hinge	Ives	5BB1HW	US32D
1	Multi-Point Lock Tornado – Office Function	Schlage	LM 9350	US26D
	Cylinder / Keying			
1	Closer, parallel arm	Norton	9500 Series	US26D
1	Wall Stop			
1	Kick Plate	Rockwood	K1050 4BE CSK	US26D
2	Perimeter Gasketing	National Guard	PF180	Black

Notes: \*

Door Hardware Set No. 07 – Classroom Function

1-1/2 pair	Butt Hinge	Ives	5BB1HW	US26D
1	Lever set – Classroom Function	Hager	3470	US26D
	Cylinder / Keying			
1	Closer, parallel arm – With Hold Open	Norton	9500 Series	US26D
1	Kick Plate	Rockwood	K1050 4BE CSK	US26D

Door Hardware Set No. 08 – Storeroom Function

1-1/2 pair	Butt Hinge	Ives	5BB1HW	US26D
1	Lever set – Storeroom Function	Hager	3480	US26D
	Cylinder / Keying			
1	Closer, parallel arm – With Hold Open	Norton	9500 Series	US26D
1	Kick Plate	Rockwood	K1050 4BE CSK	US26D

Door Hardware Set No. 09 – Mortise Privacy Function with Occupancy Indicator

1-1/2 pair	Butt Hinge	Ives	5BB1HW	US26D
1	Mortise set – Privacy Function Indicator reads Occupied/Vacant	Hager	3896	US26D
	Cylinder / Keying			
1	Closer, parallel arm – With Hold Open	Norton	9500 Series	US26D
1	Kick Plate	Rockwood	K1050 4BE CSK	US26D

Door Hardware Set No. 10 – Communicating Door

1-1/2 pair	Butt Hinge	Ives	5BB1HW	US26D
1	Lever set - Passage	Hager	3410	US26D
1	Deadlock – Double Cylinder	Hager	3114	US26D
	Cylinder / Keying			
1	Closer, parallel arm – With Hold Open	Norton	9500 Series	US26D
1	Kick Plate	Rockwood	K1050 4BE CSK	US26D

Door Hardware Set No. 11 – Office (Alternate Bid No. 1)

1-1/2 pair	Butt Hinge	Ives	5BB1HW	US26D
1	Lever set – Office Function	Hager	3450	US26D
	Cylinder / Keying			
1	Kick Plate	Rockwood	K1050 4BE CSK	US26D

Door Hardware Set No. 12 – Locker Room Entry (Alternate Bid No. 1)

1-1/2 pair	Butt Hinge	Ives	5BB1HW	US32D
1	Deadlock – Classroom Function	Hager	3118	US26D
	Cylinder / Keying			
1	Push Plate	Hager	30S – 4x16	US26D
1	Pull Plate	Hager	31E – 4x16	US26D
1	Kick Plate	Rockwood	K1050 4BE CSK	US26D

Door Hardware Set No. 13 – Storage Door Pair (Alternate Bid No. 1)

3 pair	Butt Hinge	Ives	5BB1HW	US26D
1	Deadlock – Classroom Function	Hager	3118	US26D
	Cylinder / Keying			
1 set	Manual Flush Bolt	Hager	282D	US26D
1	Dust Proof Strike	Hager	280X	US26D
2	Push Plate	Hager	30S – 4x16	US26D
2	Pull Plate	Hager	31E – 4x16	US26D
1	Kick Plate	Rockwood	K1050 4BE CSK	US26D

END OF SECTION 087100

## SECTION 088000 GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - 1. Doors.
  - 2. Storefront framing.

#### 1.2 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: 12-inch- square, for opaque glass.
- C. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer.

#### 1.3 DEFINITIONS

- A. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- B. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- C. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
- D. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or

gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
    - a. Specified Design Wind Loads: As indicated.
      - 1) Basic Wind Speed: 90mph
      - 2) Importance Factor: III.
      - 3) Exposure Category: C.
    - b. Specified Design Snow Loads: As indicated, but not less than snow loads applicable to Project as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7.0, "Snow Loads."
    - c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
      - 1) Load Duration: 3 seconds.
    - d. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
    - e. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.
  - C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
    1. Temperature Change (Range): 120°F, ambient; 180°F, material surfaces.
  - D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
    1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
    2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite 6.0 mm thick and a nominal 1/2-inch- wide interspace.
    3. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
      - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
      - b. Solar Heat Gain Coefficient: NFRC 200.
      - c. Solar Optical Properties: NFRC 300.

## 1.5 QUALITY ASSURANCE

- A. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.
- B. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
  - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
  - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Sloped Glazing Guidelines."
  - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the **Insulating Glass Certification Council**.

## 1.6 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  - 1. Warranty Period: **10** years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  - 1. Warranty Period: **10** years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GLASS PRODUCTS

- A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.
  - 1. Ultra-Clear (Low-Iron) Float Glass: Class I (clear); with a minimum 91 percent visible light transmission and a minimum solar heat gain coefficient of 0.87.
- B. Ceramic-Coated Vision Glass: Float glass with ceramic enamel applied by silk-screened process and complying with ASTM C 1048, Condition C (other coated glass), Type I (transparent flat glass), Quality-Q3, Specification No. 95-1-31 in GANA Tempering Division's "Engineering Standards Manual," and other requirements specified.

- C. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
  2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
  3. Sealing System: Dual seal.
  4. Spacer Specifications: Manufacturer's standard spacer material and construction.
  5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
    - a. Spacer Material: Aluminum with mill or clear anodic finish.
    - b. Corner Construction: Manufacturer's standard corner construction.

## 2.2 FIRE-RATED GLAZING PRODUCTS

- A. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Film-Faced Ceramic Glazing Material: Proprietary Category II safety glazing product in the form of a 3/16-inch-thick, ceramic glazing material polished on both surfaces, faced on one surface with a clear glazing film, and as follows:
1. Product: "FireLite NT" by Nippon Electric Glass Co., Ltd., and distributed by Technical Glass Products.

## 2.3 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
1. Neoprene, ASTM C 864.
  2. EPDM, ASTM C 864.
  3. Silicone, ASTM C 1115.
  4. Thermoplastic polyolefin rubber, ASTM C 1115.
  5. Any material indicated above.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
1. Neoprene.
  2. EPDM.
  3. Silicone.
  4. Thermoplastic polyolefin rubber.
  5. Any material indicated above.

## 2.4 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- B. Glazing Sealants for Fire-Resistive Glazing Products: Identical to products used in test assemblies to obtain fire-protection rating.

## 2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
  2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
1. Type 1, for glazing applications in which tape acts as the primary sealant.
  2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

## 2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

## 2.8 MONOLITHIC FLOAT-GLASS UNITS

- A. Uncoated Clear Float-Glass Units: Class 1 (clear) float glass.
  - 1. Thickness: 6.0 mm.

## 2.9 MONOLITHIC CERAMIC-COATED VISION-GLASS UNITS

- A. Ceramic-Coated Vision-Glass Units: Class 1 (clear) float glass.
  - 1. Thickness: 6.0 mm.
  - 2. Ceramic Coating Color and Pattern: Match.
    - a. Coating Location: Second surface.

## 2.10 INSULATING-GLASS UNITS

- A. Passive Solar Low-E Insulating-Glass Units:
  - 1. Overall Unit Thickness and Thickness of Each Lite: 25 and 6.0 mm.
  - 2. Interspace Content: Argon.
  - 3. Outdoor Lite: Class 1 (clear) float glass.
    - a. Annealed above 7'-0"
    - b. Kind FT (fully tempered) below 7'-0".
  - 4. Indoor Lite: Class 1 (clear) float glass.
    - a. Annealed above 7'-0"
    - b. Kind FT (fully tempered) below 7'-0".
  - 5. Low-E Coating: Pyrolytic or sputtered on second or third surface.
  - 6. Winter Nighttime U-Factor: 0.35 maximum.

7. Summer Daytime U-Factor: 0.38 maximum.
8. Solar Heat Gain Coefficient: 0.61 maximum.

## 2.11 OPAQUE GLASS

### A. Exterior Unit

1. OPAQUE white insulated glass unit.
  - a. Exterior – ¼" clear glass tempered.
  - b. Interspace – argon gas filled ½" airspace.
  - c. Interior – 1/8" clear glass tempered .060 OPAQUE white PVB interlayer 1/8" clear glass tempered.
    - 1) ¼" laminated glass makeup.

### B. Interior Unit

1. OPAQUE white insulated glass unit.
  - a. 1/8" clear glass tempered .060 OPAQUE white PVB interlayer 1/8" clear glass tempered.
    - 1) ¼" laminated glass makeup.

## PART 3 - EXECUTION

### 3.1 GLAZING

- A. General: Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
  1. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
  2. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
  3. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
  4. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
  5. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
  6. Provide spacers for glass lites where length plus width is larger than 50 inches.
  7. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

- B. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
1. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
  2. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
  3. Apply heel bead of elastomeric sealant.
  4. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
  5. Apply cap bead of elastomeric sealant over exposed edge of tape.
- C. Gasket Glazing (Dry): Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
  2. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
  3. Install gaskets so they protrude past face of glazing stops.
- D. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
  2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.2 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- B. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

## **SECTION 092216 NON-STRUCTURAL METAL FRAMING**

### **PART 1 - GENERAL**

#### 1.1 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:
  - 1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. Sound Transmission Characteristics: For STC-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### **PART 2 - PRODUCTS**

#### 2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
  - 2. Protective Coating: manufacturer's standard corrosion-resistant zinc coating, unless otherwise indicated.
  - 3. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to [5] times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
    - a. Type: Postinstalled, expansion anchor.
  - 4. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by

construction as determined by testing according to ASTM E 1190 by an independent testing agency.

- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.
  - 1. Depth: As indicated on Drawings.
- D. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
  - 2. Steel Studs: ASTM C 645.
    - a. Minimum Base-Metal Thickness: As indicated on Drawings.
    - b. Depth: As indicated on Drawings.
  - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base Metal Thickness: As indicated on Drawings.

## 2.2 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
  - 1. Minimum Base-Metal Thickness: As indicated on Drawings.
- B. Slip-Type Head Joints: Where indicated, provide one of the following:
  - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  - 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
  - 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base-Metal Thickness: 0.0312 inch.
- D. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges.
  - 1. Depth: 1-1/2 inches.
  - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base Metal Thickness: As indicated on Drawings.
  - 2. Depth: As indicated on Drawings.
  
- F. Cold-Rolled Furring Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges.
  - 1. Depth: As indicated on Drawings.
  - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch.
  - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
  
- G. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

### 2.3 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
  
- B. Isolation Strip at Exterior Walls: Provide the following:
  - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
  - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
  - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
  - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
  - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

### 3.2 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

- B. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb, unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  6. Curved Partitions:
    - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches o.c.
- C. Direct Furring:
1. Screw to wood framing.
  2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- D. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

**SECTION 092900  
GYPSUM BOARD**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Interior gypsum board.
  - 2. Tile backing panels.
  - 3. Exterior glass-mat gypsum board sheathing
  
- B. Related work
  - 1. Specified elsewhere
    - a. Metal Framing specified in Section 092216.
    - b. Painting Section 099100.

1.2 SUBMITTALS

- A. Product Data/Samples
  - 1. Submit for Engineer/Architect's approval: (minimum 5 copies required)
    - a. Manufacturer's data and/or catalog sheets clearly indicating products proposed for use.
    - b. Manufacturer's recommended installation instructions for each specific installation.

1.3 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
  
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
  
- C. Contractor shall employ only skilled and experienced workmen/workwomen who are fully qualified in the installation of specified materials and shall provide a fully qualified superintendent or foreman who shall be present at all times during execution of this work.
  
- D. Application and Finishing Standards:
  - 1. Gypsum Association File 216.
  - 2. ASTM C840.

1.4 DELIVERY, STORAGE, HANDLING

- A. All materials shall be delivered in their original unopened packages, properly labeled; stored and handled at job site in a manner to prevent damage in accordance with manufacturer's recommendations.
  - 1. Damaged or deteriorated materials shall not be used in the construction and shall be removed from the job site.

**PART 2 - PRODUCTS**

2.1 GENERAL

- A. Provide in longest lengths practicable as will result in a minimum of joints.
- B. Provide recessed or tapered edge type for single layer application and for face layer of double layer application. Use square edge type for back-up layer of double layer application.
  - 1. Provide in thickness indicated on the drawings.
- C. General: Interior gypsum board complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

2.2 Manufacturers

- A. Acceptable Manufacturers:
  - 1. National Gypsum Company
  - 2. USG Corp.
  - 3. CertainTeed Corp.
  - 4. Georgia-Pacific Gypsum LLC

2.3 Standard Gypsum Board

- A. Basis-of-Design: National Gypsum Gold Bond Brand Gypsum Board
  - 1. Panel Physical Characteristics
    - a. Core: Regular gypsum core
    - b. Surface Paper: 100 percent recycled content paper on front, back and long edges
    - c. Long Edges: Tapered
    - d. Overall thickness: As shown on drawings
    - e. Panel complies with requirements of ASTM C 1396

2.4 Abuse Resistant Gypsum Board

- A. Basis-of-Design: National Gypsum Gold Bond Brand Hi-Abuse XP Gypsum Board Performance Criteria - Wall Assembly STC: 52
  - 1. Panel Physical Characteristics

- a. Core: Fire-resistance rated gypsum core, with additives to enhance surface indentation resistance and impact resistance
- b. Surface paper: Abrasion resistant, 100 percent recycled content moisture/mold/mildew resistant paper on front, back and long edges
- c. Long Edges: Tapered
- d. Overall thickness: As shown on drawings
- e. Panel complies with Type X requirements of ASTM C 1396
- f. Surface Abrasion Resistance: Classification Level 3 in accordance with ASTM C 1629
- g. Indentation Resistance: Classification Level 1 in accordance with ASTM C 1629.
- h. Soft Body Impact Resistance: Classification Level 2 in accordance with ASTM C 1629
- i. Hard Body Impact Resistance: Classification Level 1 in accordance with ASTM C 1629.
- j. Mold/Mildew Resistance: score of 10 when tested in accordance with ASTM D 3273.

## 2.5 Impact Resistant Gypsum Board

A. Basis-of-Design: National Gypsum Gold Bond Brand Hi-Impact XP Gypsum Board

B. Performance Criteria - Wall Assembly STC: 52

### 1. Panel Physical Characteristics

- a. Core: Fire-resistance rated gypsum core, with additives to enhance mold/mildew resistance, surface indentation resistance, impact resistance and moisture and mold resistant
- b. Surface paper: Abrasion resistant, 100 percent recycled content moisture/mold/mildew resistant paper on front, back and long edges
- c. Embedded fiberglass mesh
- d. Long Edges: Tapered
- e. Overall thickness: As shown on drawings.
- f. Panel complies with Type X requirements of ASTM C 1396
- g. Surface Abrasion Resistance: Classification Level 3 in accordance with ASTM C 1629
- h. Indentation Resistance: Classification Level 1 in accordance with ASTM C 1629.
- i. Soft Body Impact Resistance: Classification Level 3 in accordance with ASTM C 1629
- j. Hard Body Impact Resistance: Classification Level 3 in accordance with ASTM C 1629.
- k. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D 3273.

## 2.6 Acoustical Gypsum Board

A. Basis-of-Design: CertainTeed SilentFX Gypsum Board

B. Performance Criteria – Wall Assembly STC: 62

### 1. Panel Physical Characteristics

- a. Laminated noise-reducing gypsum board consisting of two layers of dense gypsum board encased in smooth, moisture and mold resistant paper facings laminated

together with viscoelastic polymer noiseproofing compound. Meeting the requirements of ASTM C1766.

- b. 4. Surface Paper: 100% recycled moisture and mold resistant paper on face, back and long edges.
- c. Mold Resistance Rating:
  - 1) Score of 10 (best possible) tested in accordance with ASTM D3273
  - 2) Abuse-Resistance per ASTM C1629: Surface Abrasion – Level 1 Indentation Resistance – Level 1, Soft Body Impact – Level 1

## 2.7 Moisture Resistant XP Type Gypsum Board

### A. Basis-of-Design: National Gypsum Gold Bond Brand XP Gypsum Board

#### 1. Panel Physical Characteristics

- a. Core: Mold and moisture resistant gypsum core
- b. Surface paper: 100 percent recycled content moisture/mold/mildew resistant paper on front, back, and long edges Long Edges: Tapered
- c. Overall thickness: As shown on drawings
- d. Panel complies with requirements of ASTM C 1396
- e. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D 3273

## 2.8 Tile Backer Board

### A. Cementitious Backer Units:

- 1. Complying with ANSI A108.1.
- 2. Thickness: As indicated on Drawings.

## 2.9 EXTERIOR GYPSUM BOARD

### A. General: Complying with ASTM C 931/C931M or ASTM C 1396/C 1396M, with manufacturer's standard edges.

- 1. Thickness: As indicated on drawings.

### B. Glass-Mat Gypsum Sheathing Board:

- 1. Complying with ASTM C 1177/C 1177M.
- 2. Thickness: As indicated on drawings.

## 2.9 TRIM ACCESSORIES

### A. Interior Trim: ASTM C 1047.

- 1. Material: Formed from zinc-coated steel not lighter than 26 ga., comply with Fed Spec. QQ-S-775, Type I, Class D or E, as approved by the Engineer/Architect.
- 2. Shapes:

- a. Cornerbead.
- b. Bullnose bead.
- c. LC-Bead: J-shaped; exposed long flange receives joint compound.
- d. L-Bead: L-shaped; exposed long flange receives joint compound.
- e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
- f. Expansion (control) joint.
- g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet, or rolled zinc.
2. Shapes:
  - a. Cornerbead.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.10 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape

1. Interior Gypsum Wallboard: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all purpose compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Exterior Applications:

1. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
3. Cementitious Backer Units: As recommended by backer unit manufacturer.

## 2.11 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
  - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION AND WORKMANSHIP

- A. Comply with all pertinent recommendations of the applicable standards and manufacturer's installation recommendations for each specific type application.
- B. Installation of all materials shall be fully qualified, experienced workmen/workwomen, skilled in application of gypsum wallboard to metal framed and/or wood framed structures and skilled in the application and finishing of joint treatment specified.
- C. Panels shall be secured to framing members with screws of proper type and size spaced maximum of 10" o.c.; or by a combination of screw attachment and adhesive as may be recommended by the manufacturer and approved by the Engineer/Architect.
- D. Wallboard for ceiling shall be installed first and shall be installed in longest lengths practicable with long dimension perpendicular to framing members and with joints staggered a minimum of two framing spaces between adjacent panel rows.
  - 1. Where cross furring is indicated on the drawings, install wallboard with long dimension perpendicular to furring.
  - 2. For double layer application, reverse direction between layers.
- E. At junction of wallboard partitions with other type materials, provide continuous full height length acoustical sealant bead between wallboard edge trim and adjacent material.
- F. Neatly cut and fit wallboard to all electrical boxes and other penetrations through wallboard and provide compound filter and/or sealant bead around same to form and effective seal between wallboard surface and finishing plates.

### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.

- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load bearing partitions at structural abutments, except floors. Provide ¼" wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control jointes to counteract wood shrinkage.

### 3.3 APPLYING TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.1, at areas as indicated on drawings.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on drawings, and according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners.
  - 2. Bullnose Bead: Use where indicated on drawings.
  - 3. LC-Bead: Use at exposed panel edges.
  - 4. L-Bead: Use where indicated.
  - 5. U-Bead: Use at exposed panel edges.
  - 6. Curved-Edge Cornerbead: Use at curved openings.
- D. Exterior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners.
  - 2. LC-Bead: Use at exposed panel edges.

### 3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.

- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape. Tape and seal all joints and internal corners with reinforcing tape and joint compound. Apply tape and compound in strict accordance with manufacturer's directions and recommendations of the applicable standards.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  2. Level 2: Panels that are substrate for tile.
  3. Level 3: [Where indicated on Drawings] <Insert locations>.
  4. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in other Division 09 Sections.
  5. Level 5: Where indicated on Drawings.
    - a. Primer and its application to surfaces are specified in other Division 09 Sections.
  6. All taped and filled joints, filled depressions at screws, filled corner beads, and areas around electrical outlet boxes and other wall penetrations shall be expertly feathered out onto panel faces and sanded perfectly smooth, fully acceptable for final painting or other finish.
    - a. Careful attention shall be given to all internal corners and areas around electrical outlet boxes.
    - b. Joints shall be feathered out a minimum of 12" and further as necessary to render joints undetectable under finish painted surfaces.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.
- F. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- G. Remove and replace panels that are wet, moisture damages, and mold damaged.
1. Indications that panels are we or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

**SECTION 093013  
CERAMIC TILING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Base Bid:
  - 1. General Contractor provide:
    - a. Porcelain floor tile.
- B. Related Sections include the following:
  - 1. Division 07 Section "Joint Sealers" for sealing of joints in tile surfaces.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical information and installation instructions for materials required, except bulk materials.
- B. Samples: Submit samples for verification.
  - 1. Full-size units of each type of tile, trim and accessory for each color and finish required.
  - 2. Metal edge strips in 6-inch lengths.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with the 2016 TCNA Handbook.
- B. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
  - 1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
- D. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
  - 1. Joint sealants
  - 2. Metal edge strips

1.4 PRE-INSTALLATION MEETING

- A. Section 013100 – Coordination and Meetings

- B. Convene minimum one week prior to commencing work of this section.

#### 1.5 DELIVER, STORAGE AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.

#### 1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
- B. Vent temporary heaters to exterior to prevent damage to tile installation from carbon dioxide buildup.
- C. Maintain temperatures at not less than 50°F in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.
    - a. Minimum 1 full box of each color and texture.

### **PART 2 - PRODUCTS**

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements shown on the drawings and specified, provide Basis of Design tile products or submit a comparable product to be approved by the architect.
  - 1. Porcelain Tile:
    - a. Basis of Design: Atlas Concorde USA
    - b. American Olean Tile Co., Inc.
    - c. Dal-Tile Corp.
    - d. Crossville Inc.
    - e. Florida Tile Industries, Inc.

## 2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile" for types, compositions, and other characteristics indicated.
  - 1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.
- C. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
  - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specified in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by pre-coating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

## 2.3 TILE PRODUCTS

- A. PORCELAIN FLOOR TILE (CT-1)
  - 1. Basis of Design Product: Atlas Concorde USA; Sign
  - 2. Size: 12" x 24"
  - 3. Edge: Square
  - 4. Surface Finish: Unpolished UPS
  - 5. Color: As indicated on drawings and schedules.

## 2.4 SETTING AND GROUTING MATERIALS

- A. Available Manufacturers:
  - 1. Basis of Design Product: MAPEI Corporation
  - 2. TEC from H.B. Fuller
  - 3. LATICRETE International Inc.
- B. Setting Material: Latex-Portland Cement Mortar (Thin Set): ANSI A118.4 or ANSI A118.15
- C. Grout: ANSI A118.6 Standard Cement Grout. Use sanded grout for joints 1/8 inch wide and larger. Use unsanded grout for joints less than 1/8 inch wide. Provide water-based colorless grout sealer; liquid applied, moisture and stain protection for existing or new Portland cement grout.

## 2.5 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Crack Isolation membrane / waterproofing membrane: Comply with ANSI A118.12.
  - 1. Basis of Design Product: MAPEI; Mapelastic AquaDefense
- C. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness.
  - 1. Basis of Design Product: Schluter Systems
    - a. CT-1 to CPT-1: Schluter RENO-TK; Color: Brushed Antique Bronze Anodized Aluminum
    - b. CT-6: Schluter JOLLY; Color: Satin Nickel Anodized Aluminum
  - 2. Applications: Open edges floor tile, transitions between floor finishes of different heights.
- D. Temporary Protective Coating: Product that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
  - 1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulate and recommended for use as temporary protective coating for tile.
- E. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

## 2.6 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.

2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- B. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.
- C. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

### 3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCNA Installation Guidelines: TCNA's "Handbook for Ceramic Tile Installation." Comply with TCNA installation methods indicated in ceramic tile installation schedules.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Grind cut edges of tile abutting trim, finish, or built-in items. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile. Sound tile after setting. Replace hollow sounding units.
- E. Where tiles that have a change in thickness are adjacent, provide lippage no greater than 1/16 inch or according to ANSI A108.02.
- F. Jointing Pattern: Lay tile as indicated on drawings. Align joints when adjoining tiles on base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area, unless otherwise indicated. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
- G. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate, to prevent three-sided bonding.
- H. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tile.

1. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants".

- I. Grout tile to comply with requirements of the following tile installation standards.

1. For ceramic tile grouts (sand-portland cement; dry-set, commercial Portland cement; and latex-portland cement grouts), comply with ANSI A108.10.
2. Cementitious backer units installed under Division 09 Section "Gypsum Board" shall comply with ANSI A108.11, and manufacturer's written instructions for type of application indicated.

### 3.4 INSTALLATION – FLOORS - MORTAR BED METHOD

- A. Interior Concrete Substrates: install in accordance with TCNA Method F122, with waterproofing/crack isolation membrane, unless otherwise indicated.
  1. Waterproofing / Crack isolation membrane: Install with base flashing and as recommended by manufacturer at all toilet and shower rooms unless otherwise indicated.
  2. Mortar Bed Thickness: ¼ inch, unless otherwise indicated.
- B. Grout Joint Widths: Install tile with minimum required grout joint widths required by the manufacturer.

### 3.5 CLEANING AND PROTECTION

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  1. Remove latex-portland cement grout residue from tile as soon as possible.
  2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
  3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.
- B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- C. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 093013

**SECTION 095123**  
**ACOUSTICAL TILE CEILINGS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes acoustical tiles and concealed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed finish.
- C. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory.
- B. Fire-Test-Response Characteristics:
  - 1. Surface-Burning Characteristics: Acoustical tiles complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.
    - a. Smoke-Developed Index: 450 or less.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Units: Full-size tiles equal to five percent of quantity installed.
  - 2. Suspension System Components: Quantity of each concealed grid and exposed component equal to five percent of quantity installed.

**PART 2 - PRODUCTS**

2.1 ACOUSTICAL TILE CEILINGS, GENERAL

- A. Acoustical Tile Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.

- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with IBC design requirements.
- D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  - 1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.
- E. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
- F. Axiom Transitions, acoustical ceiling to acoustical ceiling elevation changes, straight 8", where shown on plans.

## 2.2 SUSPENSION SYSTEM

- A. Exposed grid suspension systems for interior ceilings with all standard components, main runners, cross tees, wall mouldings, splice plates, hanger wire, anchors, and other necessary accessories for 24" x 48" ceiling tile layouts (refer to reflected ceiling plan). System shall conform to requirements of ASTM C635, Intermediate Duty.
  - 1. Main Beams and Cross Tees: Double web steel, 1 1/2" height, 15/16" face dimension, metal thickness minimum .015.
  - 2. Wall moulding: Hemmed edge angle type, 15/16" x 15/16".
  - 3. Finish: Factory applied baked enamel finish for all exposed surfaces. Color: white.
  - 4. Hanger wire: Minimum No.12 galvanized.
  - 5. Armstrong "Prelude", XL Fire Guard 15/16", Exposed Tee, or Engineer/Architect approved equal.

## 2.3 LAY – IN ACOUSTICAL CEILING TILE (ACP-1 and ACP-2)

- A. Ceiling Tile (ACP-1)
  - 1. Armstrong Cortega Second Look #2767, USG Radar Illusion Two/24 #2842, or Engineer/Architect approved equal.
  - 2. Fire Class A.
  - 3. Texture: Medium Texture
  - 4. Colors: White.
  - 5. Edge Profile: 15/16" Tegular
  - 6. Humidity resistant, Humiguard.
  - 7. Mold resistant.
  - 8. Sag resistant.
  - 9. Approximately 55% recycled.
  - 10. CAC minimum: up to 35.
  - 11. NRC: up to 55
  - 12. Light reflectance: up to 84.
  - 13. Size: 24" x 48".

B. Ceiling Tile (ACP-2) – Locker Rooms Alt. #1

1. Armstrong Kitchen Zone – 672; USG Clean Room 56091, 2x4x5/8 Unperforated; or Engineer/Architect approved equal.
2. Fire Class A.
3. Texture: Smooth.
4. Color: White.
5. Edge Profile: Square Lay-in.
6. Approximately 36% recycled.
7. Humidity resistant, Humiguard
8. Mold resistant
9. Sag resistant
10. CAC minimums: up to 33.
11. NRC: up to 55.
12. Light reflectance: up to 89.
13. Size: 24" x 48".

**PART 3 - EXECUTION**

3.1 INSTALLATION

- A. Comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
  2. Do not attach hangers to steel deck tabs or to steel roof deck.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical tiles. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.

END OF SECTION 095123

**SECTION 096500  
RESILIENT FLOORING**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Work includes:

1. Provide complete, in place, the resilient flooring for the project, as shown, noted, or scheduled on the drawings and as specified herein.
  - a. Refer to drawings and finish schedules for locations of work involved.
  - b. Vinyl Composition Tile.
  - c. Resilient Base.
  - d. Resilient molding accessories.
  - e. Resilient stair tread and risers.

B. Related work:

1. Specified elsewhere:
  - a. Walk-off Tile Carpeting specified in Section 096813.

C. Pre installation Conference:

- a. Pre installation conference required with Architect for all floor patterns.

1.2 SUBMITTALS

A. Shop Drawings:

1. Submit for Engineer/Architect's approval: (minimum 5 copies required)

B. Product Data/Samples:

1. Prior to ordering materials, submit for Engineer/Architect's approval, five (5) copies of manufacturer's data or catalog sheets on all specified products together with manufacturer's recommended installation instructions.
2. Prior to ordering materials, submit for Engineer/Architect's approval, samples of the following:
  - a. Vinyl Composition Tile.
  - b. Resilient base, cove and toeless.
  - c. Tapered reducer strips, divider strips.
  - d. Resilient stair tread and riser.

### 1.3 QUALITY ASSURANCE

- A. Contractor shall employ only skilled and experienced workmen/workwomen who are fully qualified in the installation of specified materials and shall provide a fully qualified superintendent or foreman who shall be present at all times during execution of this work.
- B. In order to establish minimum quality requirements, products of certain manufacturers are listed. Products of other reputable manufacturers, which are equal in all respects to those listed, will be considered, subject to Engineer/Architect's approval.

### 1.4 DELIVERY, STORAGE, HANDLING

- A. All materials shall be delivered in their original unopened packages, properly labeled; stored and handled at job site in a manner to prevent damage or deterioration in accordance with manufacturer's recommendations.
  - 1. Damaged or deteriorated materials shall not be used in the construction work and shall be removed from the job site.

### 1.5 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time.
  - 1. 48 hours before installation
  - 2. During installation
  - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
  - 1. Install resilient products after other finishing operations, including painting, have been completed.

### 1.6 REPLACEMENT MATERIALS / EXTRA STOCK, SURPLUS MATERIAL

- A. At completion of the work, furnish and deliver to the Owner for his use in future replacement, modifications or maintenance:
  - 1. One full carton of each color or pattern of floor tile used. Make certain that tile is from same color run as the installed tile.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. Basis-of-Design: Subject to compliance with requirements, the design is based on the product named in the "Flooring Finish Schedule" and "Wall Base Schedule" on the Drawings. Provide either the named product or a comparable product by one of the other manufacturers specified.

## 2.2 RESILIENT BASE (RES-1)

- A. Resilient Base Standard: ASTM F 1861
  - 1. Material Requirement: Type TS (rubber, vulcanized thermoset).
  - 2. Manufacturing Method: Group 1 (solid, homogeneous).
  - 3. Style: Toeless at concrete floors, Coved elsewhere.
- B. Minimum Thickness: 1/8 inch
- C. Height: 4 inch (typical)
- D. Lengths: Coils in manufacturer's standard length.
- E. Colors and Patterns: As indicated on drawings and schedules. Provide either the named product or a comparable product by one of the other manufacturers specified.
  - 1. Basis of Design Product: Johnsonite
  - 2. Burke
  - 3. Flexco

## 2.3 VINYL COMPOSITION TILE (VCT-1 through VCT-11)

- A. Tile Standard: Complies with requirements for ASTM F 1066 Standard Specification for Vinyl Composition Floor Tile, Class 1 (Solid Color) and Class 2 (Through Pattern).
- B. Thickness: 0.125-inch
- C. Colors: As indicated on drawings and schedules.
- D. Size: 12"x12" tile
- E. Refer to drawings for patterns and color locations.
- F. Manufacturer, Colors and Patterns: As indicated on the drawings and schedules. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.
  - 1. Basis of Design Product: Armstrong World Industries, Inc.
  - 2. Congoleum Corporation
  - 3. Mannington Mills, Inc.
  - 4. Tarkett, Inc.

## 2.4 RESILIENT MOLDING ACCESSORIES

- A. Description: Carpet edge for glue-down applications, reducer strip for resilient floor covering, joiner for tile and carpet, reducer strip for resilient stair tread to sealed concrete, joiner for tile and resinous flooring, and transition strips at door openings where flooring material changes.
  - 1. WLK to VCT
  - 2. VCT to CT
  - 3. VCT to WD
  - 4. RES to SC

- B. Material: Vinyl / Rubber
- C. Colors and Patterns: As indicated on drawings and schedules.
- D. Acceptable manufacturers:
  - 1. Basis of Design Product: Johnsonite.
  - 2. Burke.
  - 3. Flexco.

## 2.5 RESILIENT STAIR TREAD AND RISERS

- A. Rubber Stair Standard: Complies with ASTM F 2169, Type TS, Class 1 & 2, Group 1 & 2
  - 1. Homogeneous composition of 100% synthetic rubber.
  - 2. Integrated tread and riser.
  - 3. Visually Impaired treads with 2" wide contrasting grit tape.
  - 4. Lengths to cover stair tread in one piece.

## 2.6 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Cove Base Adhesives: Not more than 50 g/L
    - b. Floor Adhesive: Not more than 60 g/L
- C. Stair Tread and Nose Filler: Johnsonite #930 Two-Part Epoxy Caulking Compound to fill nosing substrates that do not conform to tread contours.

## 2.7 ACCESSORIES

- A. Floor Polish: Provide protective liquid floor polish products for vinyl composition tile as recommended by resilient manufacturer.

## **PART 3 - EXECUTION**

### 3.1 SURFACE CONDITIONS/JOB CONDITIONS

- A. General Contractor shall turn over all floor surfaces to flooring contractor in broom-clean condition. Flooring contractor shall inspect all floors prior to installation of any materials. Correct conditions detrimental to proper installation. Do not proceed with work of this section until unsatisfactory conditions have been corrected.

- B. Verify that substrate is smooth, level, at required finish elevation, and without more than 1/8" in 10'-0" variation from level or slopes shown on the drawings. Existing vinyl tile shall remain, re-adhere any loose tile. Patch voids in existing vinyl tile as necessary with like-thickness material to provide suitable substrate for new resilient flooring. Remove all wax, etc. as necessary to insure bond for new resilient flooring.
- C. General finishing operations, including painting, should be completed and permanent heating system should be in operation prior to starting this work.
- D. Temperature of at least 70° F shall be maintained:
  - 1. In areas where flooring materials are stored during the 24 hour period immediately prior to installation.
  - 2. In areas where resilient flooring is to be installed, during installation, and for 48 hours thereafter.

### 3.2 PREPARATION

- A. Concrete curing agents, sealers or hardeners should be removed.
- B. Rough concrete floors shall have projections and trowel marks removed to a satisfactory condition.
- C. Depressions in concrete floors shall be primed with emulsified asphalt thinned to a brushing consistency and filled with a mixture of 1 part high early strength cement, 2 parts sand, and 1 part emulsified asphalt tempered with water to a plastic mortar as dry as can be placed. Allow filler to thoroughly cure and harden before flooring is installed.
- D. Floor surfaces shall be thoroughly cleaned and dry mopped to ensure removal of all dirt, grit, or other material which would prevent bonding or which would indent flooring material.
- E. Prepare Substrates according to ASTM F 710 including the following:
  - 1. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Results must not exceed 5 lbs. Moisture Vapor Emission Rate per 1,000 sq. ft. in 24 hours.
  - or –
  - b. Perform relative humidity test using in situ probes, ASTM F 2170. Must not exceed 80%.
- 2. A pH test for alkalinity must be conducted. Results should range between 7 and 9. If the test results are not within the acceptable range of 7 to 9, the installation must not proceed until the problem has been corrected.
- 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.

### 3.3 INSTALLATION

- A. General:

1. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within limits recommended by manufacturers of materials to be used.
2. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on the finish surface as marked on the subfloor. Use chalk or other non-permanent marking device.
3. Apply approved adhesives in strict accordance with the manufacturer's recommendations and install flooring only when adhesive has reached correct consistency.
4. Butt flooring tightly to vertical surfaces, nosings, edgings, thresholds, etc.
5. Expertly scribe around pipes and other obstructions to produce neat appearance.
6. Extend flooring into toe spaces, door reveals, and similar spaces.
7. Install tapered reducer strips at all exposed edges of resilient flooring.
8. Roll flooring with minimum 100 lb. roller. Provide smooth finished floor installation, free of buckles, cracks, waves, or unsightly joints.

B. Installing Floor Tile:

1. Install using tile from a number of open cartons to prevent noticeable color change lines.
2. Install all tile in straight line pattern unless specifically indicated otherwise on drawings.
3. Install all tile with pattern design.
4. Tile shall be installed symmetrical about center lines of rooms or areas generally but layout shall be carefully considered and modified as necessary to eliminate small or thin pieces at walls, for best overall appearance.
5. Install divider strips under doors as necessary between rooms or areas for off-setting pattern lines.
6. Refer to Floor Pattern Plan on Drawings. Verify with Engineer/Architect, layout of floor tile pattern and use of divider strips.

C. Installing Rubber Base:

1. Install base for all areas indicated in finish schedule on drawings and at all toe space of casework.
2. Install with minimum joints.
3. Furnish and install factory pre-formed exterior corners unless noted otherwise.

D. Resilient Accessory Installation:

1. Comply with manufacturer's written instructions for installing resilient accessories.
2. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of resilient floor covering that would otherwise be exposed.

E. Resilient Stair Tread and Nosing:

1. Comply with manufacturer's written instructions for installing resilient accessories.
2. Use Johnsonite #930 Epoxy Caulking Compound to strengthen nosing and fill irregularities in substrates to conform to tread nosing.
3. Tightly adhere to substrates throughout length of each piece.
4. For treads installed as separate, equal-length units, install to produce a flush joint between units.

### 3.4 ADJUSTMENTS AND CLEANING

- A. At conclusion of the work, examine entire installation. Replace all damaged tile and leave entire installation free from defects.

- B. Remove all excess adhesive from face of flooring. Thoroughly clean and remove all marks, mastic spots, etc. from floors and other surfaces.
- C. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- D. Floor Polish: Remove wax, soil, visible adhesive and surface blemishes from resilient flooring before applying liquid floor polish.
  - 1. Apply two coats to Vinyl Composition Tile.
- E. Cover resilient products until Substantial Completion.

END OF SECTION 096500

**SECTION 096813**  
**TILE CARPETING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes modular walk-off carpet tile.
- B. Related Sections:
  - 1. Division 9 Section "Resilient Flooring" for resilient wall base and accessories installed with carpet tile.

1.2 SUBMITTALS

- A. Product Data: For each product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in Schedules.
  - 1. Carpet Tile: Full-size Sample.
- C. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- D. Qualification Data: For Installer
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by qualified testing agency.
- F. Maintenance data: For carpet tiles to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- G. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.6 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge and delamination.
  - 1. Warranty Period: 2 years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Basis-of-Design: Subject to compliance with requirements, provide products indicated on drawings and schedules. Provide either the named product or a comparable product by one of the other manufacturers specified.
  - 1. Basis of Design Product: Tandus Centiva

2. J & J Invision
3. Interface
4. Lees

## 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
  1. VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D 5116:
    - a. Total VOCs: 10.00 mg/sq. m x h.
    - b. Formaldehyde: 0.05 mg/sq. m x h.
    - c. 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h.
- C. Transition: See section 096500

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
  2. Subfloors are free of cracks, ridges, depressions, scale and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2 "Site Conditions: Floor Preparation", and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch or wider and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.

- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### 3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- D. Install pattern parallel to walls.

### 3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing carpet tile:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  - 2. Remove yarns that protrude from carpet tile surface.
  - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

**SECTION 099100**  
**PAINTING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Work included: Provide complete, in place, the painting work for the project, as shown, noted, or scheduled on the drawings and as specified herein.
- B. Related Sections: The following sections contain requirements that relate to this section:
  - 1. Section 062000 Finish Carpentry
  - 2. Division 08 "Hollow Metal Doors and Frames" for shop priming steel doors and frames.

1.2 SUBMITTALS

- A. In accord with 013300:
  - 1. Product data:
    - a. Materials list of items proposed to be provided under this Section;
    - b. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
    - c. Two (2) Drawdowns for each color and sheen shown on drawings and schedules.

1.3 RELATED WORK

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary conditions, and Sections in Division 1 of these Specifications.
- B. Priming or priming and finishing of certain surfaces may be specified to be factory-performed or installer-performed under pertinent other Sections.

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Paint coordination:
  - 1. Provide finish coats which are compatible with the prime coats actually used.
  - 2. Review other Sections of these Specifications as required, verifying the prime coat to be used and assuring compatibility of the total coating system for the various substrata.
  - 3. Upon request, furnish information on the characteristics of the specific finish materials to assure that compatible prime coats are used.
  - 4. Provide barrier coats over noncompatible primers, or remove the primer and reprime as required.

5. Notify the Architect/Engineer in writing of anticipated problems in using the specified coating systems over prime-coatings supplied under other Sections.

#### 1.5 PRODUCT STORAGE & PROTECTION

- A. Comply with pertinent provisions of Section 016600.

#### 1.6 JOB CONDITIONS

- A. Do not apply solvent-thinned paints when the temperature of surfaces to be painted and the surrounding air temperatures are below 45 degrees F, unless otherwise permitted by the manufacturers' printed instructions as approved by the Architect/Engineer.
- B. Weather conditions:
  1. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or to damp or wet surfaces, unless otherwise permitted by the manufacturers' printed instructions as approved by the Architect/Engineer.
  2. Applications may be continued during inclement weather only within the temperature limits specified by the paint manufacturer as being suitable for use during application and drying periods.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Basis-of-Design: Subject to compliance with requirements, provide named product by Sherwin Williams or an APPROVED comparable product by one of the following:
  1. Benjamin Moore Paints
  2. Glidden Professional
  3. M.A.B. Paints
  4. PPG Architectural Finishes, Inc.
- B. Undercoats and thinners:
  1. Provide undercoat paint produced by the same manufacturer as the finish coat.
  2. Use only the thinners recommended by the paint manufacturer, and use only to the recommended limits.
  3. Insofar as practicable, use undercoat, finish coat, and thinner material as parts of a unified system of paint finish.

#### 2.2 PAINT MATERIALS

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Undercoats and thinners:

1. Provide undercoat paint produced by the same manufacturer as the finish coat.
  2. Use only the thinners recommended by the paint manufacturer, and use only to the recommended limits.
  3. Insofar as practicable, use undercoat, finish coat, and thinner material as parts of a unified system of paint finish.
- C. Colors: Match colors indicated by manufacturer's designations on the drawings and schedules as selected from manufacturer's full range.
1. Manufacturer's names listed in the "Wall Finish Schedule" on the drawings are for color selection only. Other manufacturers shall match color indicated.

## 2.3 APPLICATION EQUIPMENT

- A. For application of the approved paint, use only such equipment as is recommended for application of the particular paint by the manufacturer of the particular paint, and as approved by the Architect/Engineer.

## 2.4 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect/Engineer.

## **PART 3 - EXECUTION**

### 3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

### 3.2 MATERIALS PREPARATION

- A. General:
1. Mix and prepare paint materials in strict accordance with the manufacturers' recommendations as approved by the Architect/Engineer.
  2. When materials are not in use, store in tightly covered containers.
  3. Maintain containers used in storage, mixing, and application of paint in a clean condition, free from foreign materials and residue.
  4. Do not stir into the material any film which may form on the surface, but remove the film and, if necessary, strain the material before using.

### 3.3 SURFACE PREPARATION

- A. General:

1. Perform preparation and cleaning procedures in strict accordance with the paint manufacturers' recommendations as approved by the Architect/Engineer.
  2. Remove removable items, which are in place and are not scheduled to receive paint finish; or provide surface-applied protection prior to surface preparation and painting operations.
  3. Following completion of painting in each space or area, reinstall the removed items by using workers who are skilled in the necessary trades.
  4. Clean each surface to be painted prior to applying paint or surface treatment.
  5. Remove oil and grease with clean cloths and cleaning solvent of low toxicity and flash point in excess of 200 degrees F, prior to start of mechanical cleaning.
- B. Preparation of all new metal surfaces to receive paint:
1. Thoroughly clean surfaces until free from dirt, oil, and grease.
  2. On galvanized surfaces, use solvent for the initial cleaning, then treat the surface thoroughly with phosphoric acid etch. Remove etching solution completely before proceeding.
  3. Allow to dry thoroughly before application of paint.
- C. Preparation of all new wood surfaces to receive paint:
1. Smooth finished wood surfaces exposed to view, using the proper sandpaper. Where so required, use varying degrees of coarseness in sandpaper to produce a uniformly smooth and unmarred wood surface.
  2. Unless specifically approved by the Engineer/Architect, do not proceed with painting of wood surfaces until the moisture content of the wood is 14% or less as measured by a moisture meter approved by the Engineer/Architect.
- D. Preparation of all new drywall surfaces to receive paint:
1. Thoroughly examine surfaces prior to and again after prime coat is applied. Joints and holes shall be properly filled, feathered out and sanded perfectly smooth to prevent detection of same through specified finish paint.
    - a. Do not apply finish coats until all unsatisfactory conditions have been corrected.
- E. Preparation of all new concrete block or concrete surfaces to receive paint:
1. Surfaces shall be thoroughly dry, free from dirt and dust; shall have mortar projections and splatters removed; shall have holes, cracks, and joints properly filled; mortar joints rubbed or stoned smooth; and surfaces otherwise properly prepared to receive the specified paint or special coatings.
    - a. If surfaces cannot be properly prepared, the conditions shall be reported to the General Contractor and Architect/Engineer.
    - b. Do not apply finish coats until all unsatisfactory conditions have been corrected.

### 3.4 PAINT APPLICATION

#### A. General:

1. Touchup shop-applied prime coats which have been damaged, and touchup bare areas prior to start of finish coats application.
2. Slightly vary the color of succeeding coats.

- a. Do not apply additional coats until the completed coat has been inspected and approved.
  - b. Only the inspected and approved coats of paint will be considered in determining the number of coats applied.
3. Sand and dust between coats to remove defects visible to the unaided eye from a distance of five feet.

B. Drying:

1. Allow sufficient drying time between coats, modifying the period as recommended by the material manufacturer to suit adverse weather conditions.
2. Consider oil-base and oleo-resinous solvent-type paint as dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and when the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Brush applications:

1. Brush out and work the brush coats onto the surface in an even film.
2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, and other surface imperfections will not be acceptable.

D. Spray application:

1. Except as specifically otherwise approved by the engineer/architect, confine spray application to metal framework and similar surfaces where hand brush work would be inferior.
2. Where spray application is used, apply each coat to provide the hiding equivalent of brush coats.
3. Do not double back with spray equipment to build up film thickness of two coats in one pass.

E. Miscellaneous surfaces and procedures:

1. Exposed mechanical items:
  - a. Finish electric panels, access doors, conduits, outlet boxes, grilles, registers, vents, and items of similar nature to match the adjacent wall and ceiling surfaces, or as directed by the Engineer/Architect.
  - b. Wash metal with solvent, prime, and apply two coats of latex enamel.

### 3.5 PAINTING SCHEDULE

A. Provide the following paint finishes: Refer to 3.4.A.1 concerning specified prime coats.

B. Exterior and Interior unless noted otherwise:

1. All exposed plain iron and steel.
  - a. Includes but not limited to:

- 1) Hollow Metal Doors and Frames.
    - 2) Stair stringers and railings
    - 3) Exposed structural and miscellaneous steel, ladders
    - 4) Exposed gas piping (interior and exterior).
  - b. Finish System:
    - 1) Sherwin Williams.
      - a) First/Prime Coat: DTM Acrylic Primer/Finish.
      - b) Second and Third Coat: ProMar 200 Zero VOC Latex Semi-Gloss Enamel.
  - c. Exposed structural steel shall have shop prime coat touched up at welds, connections and abraided areas as necessary.
2. All exposed galvanized.
  - a. Includes but not limited to:
    - 1) Exposed galvanized mechanical piping and electrical conduit.
    - 2) Exposed spiral ductwork
    - 3) Hollow Metal Doors and Frames
    - 4) Stair stringers and railings
  - b. Finish System:
    - 1) Sherwin Williams:
      - a) First/Prime Coat: DTM Acrylic Primer/Finish.
      - b) Second and Third Coat: ProMar 200 Zero VOC Latex Semi-Gloss Enamel.
3. Wood Surfaces, Trim, and Finish
  - a. Includes but not limited to:
    - 1) Miscellaneous wood trim, oak-faced plywood paneling, etc.
  - b. Finish system shall consist of three coat paint system.
    - 1) Sherwin Williams:
      - a) First/Prime Coat: ProMar 200 Interior Enamel Undercoater.
      - b) Second and Third Coats; ProMar 200 Zero VOC Interior Latex Semi-Gloss Enamel.

-or-
  - c. Finish system shall consist of three coat stain/varnish system:
    - 1) Sherwin Williams:
      - a) First Coat: Oil Stain.
      - b) Polyurethane Varnish, Gloss.

c) Polyurethane Varnish, Satin.

4. Gypsum Board areas:

a. Finish system:

1) Sherwin Williams:

- a) First Coat: ProMar 200 Latex Wall Primer.
- b) Second and Third Coats: ProMar 200 Zero VOC Interior Latex Eggshell Enamel.

b. All walls inside toilet rooms and as noted to receive epoxy paint shall receive:

- a) First Coat: latex primer.
- b) Second and Third Coats: Water based catalyzed epoxy.

5. Interior Pre-cast Concrete/Concrete Block areas:

a. Finish system:

1) Sherwin Williams:

- a) First Coat: PrepRite Block Filler.
- b) Second and Third Coats: ProMar 200 Zero VOC Interior Latex Eggshell Enamel.

b. All walls inside toilet rooms and as noted to receive epoxy paint shall receive:

1) Sherwin Williams:

- a) First Coat: PrepRite Block Filler.
- b) Second and Third Coats: Water based catalyzed epoxy.

6. Exposed pre-cast concrete roof deck and exposed metal deck/bar joists.

a. Finish system:

1) Sherwin Williams:

- a) First Coat: Pro Industrial Waterborne Acrylic Dryfall Eggshell

END OF SECTION 099100

## **SECTION 101420 INTERIOR SIGNAGE**

### **PART 1 GENERAL**

#### 1.1 SUMMARY

- A. Section includes interior regulatory identification signs.

#### 1.2 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, overall dimensions of each sign.

#### 1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Illinois standard.
- B. Maintain one copy of each document on site.

#### 1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Package signs, labeled in name groups.
- C. Store adhesive attachment tape at ambient room temperatures.

#### 1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install signs when ambient temperature is lower than recommended by manufacturer.
- C. Maintain this minimum temperature during and after installation of signs.

### **PART 2 PRODUCTS**

#### 2.1 INTERIOR SIGNS

- A. Manufacturers:
  - 1. Basis of Design: Inpro Corp.

2. ASI Signs
  3. Substitutions: Section 016000 - Product Requirements.
- B. Product Description: ADA Regulatory and Room ID signage.

## 2.2 COMPONENTS

- A. Injection Molded Signs, Base Material: Rigid Vinyl - Basis of Design Product: InPro Corporation: Signscape Architectural Signage
1. Sign Colors: As indicated on drawings and schedules.
  2. Panel Construction: Provide rigid vinyl panels composed of .032" thick moisture resistant, rigid vinyl sign base. Panel shall be single piece construction. Panel thicknesses shall be 1/16", 1/8" or 1/4". Maximum panel size shall be 18" x 24".
  3. Size: As indicated for each sign type on drawings and schedules.
  4. Edges: Square
  5. Character Font: ADA Avenir
  6. Character Color: Black
  7. Pictograms - Raised Tactile International Symbols, including handicap accessible symbol.
  8. Margins: As indicated on Drawings and Schedules
  9. Messages: As indicated on Drawings and Schedules. Grade 2 Accompanying Braille

## 2.3 ACCESSORIES

- A. Tape Adhesive: Double sided tape, permanent adhesive.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

### 3.2 INSTALLATION

- A. Install signs after wall surfaces are finished, in locations indicated on Drawings and schedules.
- B. Position vertical center line of sign within 18 inches from strike side of door, level.
- C. Position horizontal center line of sign on wall surface between 48" min and 60" max above finished floor, level.
- D. Install all signs at the same position, relative to the strike side of the door.

END OF SECTION 101420

**SECTION 102600**  
**WALL AND DOOR PROTECTION**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Provide wall corner guards at all outside corners of gypsum wallboard.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include sections, details, and attachments to other work.
- C. Samples: For each type of unit and for each color and texture required.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide impact-resistant, plastic wall-protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store plastic wall-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70°F.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Basis-of-Design Product: The design for each impact-resistant wall-protection unit is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

## 2.2 MATERIALS

- A. Extruded Rigid Plastic: High-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout.
- B. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.
  - 1. Use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Gypsum Board and Panel Adhesives: 50 g/L.
    - b. Multipurpose Construction Adhesives: 70 g/L.
    - c. Contact Adhesive: 250 g/L.
- C. Surface-Mounted, Opaque-Plastic Corner Guards: Fabricated from PVC plastic, acrylic-modified vinyl sheet or opaque polycarbonate sheet; with formed edges; fabricated with 90- degree turn to match wall condition.
  - 1. Basis-of-Design Product: IPC Door and Wall Protection Flexible Corner Guard, or a comparable product by one of the following:
  - 2. Manufacturers:
    - a. Construction Specialties, Inc.
    - b. Korogard Wall Protection Systems; Division of RJF International Corporation.
  - 3. Wing Size: Nominal 2 by 2 inches x 9' high.
  - 4. Mounting: Adhesive.
  - 5. Color and Texture: Refer to plans for color selection.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.
- B. Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
  - 1. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
- C. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- D. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

## SECTION 102813 TOILET ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Work includes

1. Provide complete, in place, the toilet accessories for the project, as shown, noted, or scheduled on the drawings and as specified herein.

#### 1.2 SUBMITTALS

A. Product Data/Samples

1. Submit for Engineer/Architect's approval: (minimum 5 copies required)
  - a. Manufacturer's catalog or data sheets on all specified products together with manufacturer's recommended installation instructions.

#### 1.3 QUALITY ASSURANCE

- A. Contractor shall employ only skilled and experienced workmen/workwomen who are fully qualified and familiar with the assembly and recommended installation procedures for specified products.

### PART 2 - PRODUCTS

#### 2.1 GRAB BARS

- A. 1-1/4" OD, Type 304 Stainless Steel, 18 gauge, smooth satin finish, concealed mounting type. Provide in lengths and configurations indicated on the drawings.

1. Acceptable Products

- a. Bobrick "B-5806 Series".
- b. Bradley "832 Series".
- c. American Specialties, Inc., 3700 Series Grab Bars
- d. Approved equal.

#### 2.2 MIRRORS

- A. No. 1 quality 1/4" plate/float glass, electrolytically copper backed, edges and back protected with shock absorbing material, heavy gauge galvanized steel back, concealed wall hangers slotted for concealed mounting with theft-resistant devices. Provide type 304 stainless steel square

corner channel frames with polished finish. Provide mirrors in sizes noted or indicated on the drawings.

1. Acceptable products
  - a. Bradley "781 Series".
  - b. Bobrick "B-165 Series".
  - c. American Specialties, Inc., 0620 Series Mirrors
  - d. Approved equal.

## 2.3 BABY CHANGING STATION

- A. Provide surface mounted molded plastic folding baby changing station; 1 location.
- B. Acceptable Products:
  1. Bradley "9612"
  2. Bobrick "KB100-00"
  3. ASI "9012"

## 2.4 MISCELLANEOUS MATERIALS / ACCESSORIES

- A. Provide proper type anchoring devices for specific type wall construction or partition type involved for securing all items.

## **PART 3 - EXECUTION**

### 3.1 INSTALLATION

- A. Coordinate as required with other trades to assure proper and adequate provisions in the work of those trades for interface with the work of this section, including proper wood backing in building partitions.
- B. Install each item in its proper location, firmly anchored into position, level and plumb, and in accordance with manufacturer's recommendations and proper installation templates.

END OF SECTION 102813

**SECTION 104414  
FIRE EXTINGUISHERS AND CABINETS**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Work includes

1. Provide complete, in place, the fire extinguishers and cabinets for the project, as shown, noted, or scheduled on the drawings and as specified herein.
  - a. Refer to drawings for locations and for details of wall construction and conditions.

1.2 SUBMITTALS

A. Product Data/Samples

1. Submit for Engineer/Architect's approval: (minimum 5 copies required)
  - a. Manufacturer's catalog or data sheets on specified fire extinguishers and cabinets together with manufacturer's recommended installation instructions.

1.3 QUALITY ASSURANCE

- A. Contractor shall employ only skilled and experienced workmen/workwomen who are fully qualified and familiar with the recommended installation procedures for the specified products and the wall construction involved.

**PART 2 - PRODUCTS**

2.1 EXTINGUISHERS AND CABINETS

A. Marked "FEC" on Drawings:

1. Multi-Purpose Dry Chemical Extinguisher, heavy duty steel cylinder, class A B & C fires, 10 lb. capacity, rated 4A-60BC. Provide with cabinet of cold rolled steel, white epoxy finish, semi-recessed type with 2½" trim, steel frame, duo-panel glazed door (DSA), continuous hinge, zinc plated pull handle, roller catch, for wall opening 11½" x 25" x 4".

B. Marked "FE" on Drawings:

1. Same as above, less cabinet. Provide wall mounting hardware.

C. Approved Products

1. J. L. Industries "Cosmic 10E", "Ambassador 1017D10".
2. Engineer/Architect approved equal.

- D. Provide extinguishers fully charged, ready for service, and provide all accessories required for complete installation.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install cabinets in prepared openings in accordance with the applicable drawing details and approved submittals, and as recommended by the manufacturer.
- B. Install wall hung units using proper mounting hardware as supplied with units, for rigid installation.
- C. Mounting Heights: As detailed on the drawings, or as directed by the Engineer/Architect.

END OF SECTION 104414

**SECTION 123200  
MANUFACTURED WOOD CASEWORK**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Plastic-laminate-faced wood cabinets of stock design.
  - 2. Plastic-laminate-faced countertops.
  - 3. Solid-surface countertop and window sills.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For cabinet finishes and for each type of top material indicated.

1.3 DEFINITIONS

- A. MDF: Medium-density fiberboard.
- B. PL: Plastic Laminate
- C. RCB: Rubber Cove Base

1.4 QUALITY ASSURANCE

- A. Quality Standard: Unless otherwise indicated, comply with requirements for modular cabinets in AWI's "Architectural Woodwork Quality Standards."
- B. Product Designations: Drawings indicate sizes, configurations, and finish material of manufactured wood casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish material, and complying with the Specifications may be considered. Refer to Division 01 Section "Product Requirements."

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of manufactured wood casework that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:

- a. Delamination of components or other failures of glue bond.
  - b. Warping of components.
  - c. Failure of operating hardware.
  - d. Deterioration of finishes.
2. Warranty Period: 3 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Plastic-Laminate-Faced Manufactured Casework:
    - a. CampbellRhea; a Sagas International company.
    - b. TMI Systems, Corp.
    - c. Stevens Industries, Inc.

### **2.2 MATERIALS, GENERAL**

- A. Low-Emitting Materials: Provide manufactured wood casework, including countertops, made with adhesives and composite wood products containing no urea formaldehyde.
- B. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- C. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core unless otherwise indicated.
- D. Softwood Plywood: DOC PS 1.
- E. Particleboard: ANSI A208.1, Grade M-2.
- F. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
- G. Hardboard: AHA A135.4, Class 1 Tempered.
- H. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
- I. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Basis of Design: Wilsonart International; Div. of Premark International, Inc.
    - b. Avonite Surfaces; Aristech Acrylics LLC.
    - c. E. I. du Pont de Nemours and Company.
    - d. Formica Corporation.
    - e. Nevamar Company, LLC; Decorative Products Div.

- J. Thermoset Decorative Panels: Particleboard or Medium-Density Fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- K. Edgebanding for Plastic Laminate: Plastic laminate adjacent surfaces Rigid PVC extrusions, through matching color with satin finish, 2 mm thick at doors and drawer fronts. Color to match adjacent surface as closely as possible.
- L. Edgebanding for Thermoset Decorative Panels: PVC or polyester edge banding complying with LMA EDG-1 and matching thermoset decorative panels.

## 2.3 CABINET MATERIALS

- A. Exposed Cabinet Materials:
  - 1. Plastic Laminate: Grade VGS.
- B. Semiexposed Cabinet Materials:
  - 1. Plastic Laminate: Grade VGS.
    - a. Provide plastic laminate for semiexposed surfaces unless otherwise indicated.
    - b. Provide plastic laminate for interior faces of doors and drawer fronts.
  - 2. Thermoset Decorative Panels: Provide thermoset decorative panels for semiexposed surfaces unless otherwise indicated.

## 2.4 DESIGN, COLOR, AND FINISH

- A. Design: Provide manufactured wood casework of the following design:
  - 1. Flush overlay with dark bronze finished wire pulls.
- B. Wood Colors and Finishes: As selected by Architect from casework manufacturer's full range.
- C. Thermoset Decorative Panel Colors, Patterns, and Finishes: As selected by Architect from casework manufacturer's full range].
- D. Plastic-Laminate Colors, Patterns, and Finishes: As indicated on drawings and schedules.
- E. PVC Edgebanding Color: As selected from casework manufacturer's full range.
- F. Solid-Surfacing Material Colors and Patterns: As indicated on drawings and schedules.

## 2.5 CASEWORK HARDWARE

- A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard dark bronze satin-finish, commercial-quality, heavy-duty hardware.
  - 1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

- B. Frameless Concealed Hinges: BHMA A156.9, Type B01602, self-closing.
- C. Door/Drawer Pulls: Back-mounted, solid brass rod style, 4 inches long, 5/16 inch in diameter, dark bronze satin finish.
- D. Door Catches: Dual, self-aligning, permanent magnet catch.
- E. Drawer Slides: BHMA A156.9, Type B05091.
  - 1. Box Drawer Slides: Grade 1.
  - 2. File Drawer Slides: Grade 1HD-100.
  - 3. Pencil Drawer Slides: Grade 1.
- F. Drawer and Hinged Door Locks: Cylindrical (cam) type, 5-pin tumbler, complying with BHMA A156.11, Grade 1.

### **PART 3 - EXECUTION**

#### **3.1 CASEWORK INSTALLATION**

- A. Install level, plumb, and true; shim as required, using concealed shims. Where manufactured wood casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust sub-tops within 1/16 inch of a single plane. Fasten cabinets to masonry or framing, wood blocking, or reinforcements in walls and partitions with fasteners spaced 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
- C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, or framing, blocking, or reinforcements in walls or partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
- D. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

#### **3.2 CLEANING AND PROTECTING**

- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- B. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123200

## SECTION 211000 WATER BASED FIRE SUPPRESSION SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following fire-suppression piping inside the building:
  - 1. Wet-pipe sprinkler systems.

#### 1.3 SUBMITTALS

- A. Product Data: For the following:
  - 1. Piping materials including sprinkler specialty fittings.
  - 2. Pipe hangers and supports.
  - 3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
  - 4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
  - 5. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
  - 6. Alarm devices, including electrical data.
  - 7. Backflow preventer. Include pressure drop chart, and dimensioned drawing
- B. Fire-hydrant flow test report.
- C. Approved Sprinkler Piping Drawings: Design drawings, prepared according to NFPA 13, bearing the stamped approval of the authorities having jurisdiction, including hydraulic calculations.
  - 1. Design drawings shall include the complete overhead sprinkler system and all other potential construction interferences: HVAC diffusers, light fixtures, structural steel, etc
  - 2. Design drawing shall include a plan showing the location of underground connections, control valves, and related items
  - 3. Design drawings shall include any details and section necessary to clarify the design.
  - 4. Design drawings shall be stamped by the professional engineer retained by the Installer and described in the Quality Assurance section of this Specification.
  - 5. Design drawings shall show the location of all alarm devices to be connected to the Fire Detection and Alarm System.
- D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "[Contractor's Material and Test Certificate for Aboveground Piping](#)" and "Contractor's Material and Test Certificate for Underground Piping."

1. Two (2) completed copies are to be provided to the Engineer
  2. One (1) completed copy shall be provided to the authority having jurisdiction
- E. Operation Manual: Provide three (3) hard copies in separate binders and an electronic copy. Include the following:
1. Copy of product data
  2. Copy of fire hydrant test report
  3. Copy of Sprinkler Piping Diagrams
  4. Copy of Contractor's Material and Test Certificate for Aboveground Piping
  5. Copy of final letter of acceptance from authority having jurisdiction
  6. Schedule and description of required maintenance activities
- F. Provide two (2) copies of the final letter of acceptance from the authority having jurisdiction after the system has been completely installed, tested, and accepted.

#### 1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
- B. The proposed sprinkler system shall be designed to meet NFPA 13 requirements without the use of a fire pump.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
1. Sprinkler Occupancy Hazard Classifications: As shown on the Drawings in accordance with applicable NFPA standards and subject to the approval of the authorities having jurisdiction.
  2. Minimum Density Sprinkler Piping Design: As shown on the Drawings in accordance with applicable NFPA standards and subject to the approval of the authorities having jurisdiction.
  3. Maximum Protection Area per Sprinkler: According to applicable NFPA standards and UL listing requirements, unless otherwise indicated.
  4. Total Combined Hose-Stream Demand Requirement: According to applicable NFPA standards, unless otherwise indicated:
- C. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
- D. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.

## 1.6 QUALITY ASSURANCE

### A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test performed by the installer.
  - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer licensed in the state which the project is located.
  - b. Installer shall be a company specializing in the installation of Fire Protection Systems with a minimum of three (3) years experience.

### B. Perform work in accordance with the Fire Rating Bureau having jurisdiction, the applicable NFPA Standard listed below, and Factory Mutual Standards.

1. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13, "Installation of Sprinkler Systems."

### C. Equipment and Components shall bear FM label or marking.

## 1.7 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Coordinate alarm, trouble and supervisory signals originating at equipment supplied under this Section with the fire detection and alarm system.

## 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project. Location of cabinet(s) shall be coordinated with Engineer.

## **PART 2 - PRODUCTS**

### 2.1 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and/or required with factory- or field-formed threaded ends.
  1. Cast-Iron Threaded Flanges: ASME B16.1.

2. Malleable-Iron Threaded Fittings: ASME B16.3.
  3. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated and/or required. Include ends matching joining method.
  4. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated and/or required.
- B. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory- or field-formed, roll-grooved ends.
- a. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
  - b. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

## 2.2 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
- C. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

## 2.3 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- A. Ball Valves: Comply with UL 1091, except with ball instead of disc.
1. NPS 2 and smaller: Bronze body with ends matching connecting piping.
- B. Butterfly Valves: UL 1091.
1. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; with flanged or grooved ends.
- C. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
- D. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch.
  2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and ends matching connecting piping.

3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; with flanged or grooved ends.

## 2.4 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and ends matching connecting piping.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and ends matching connecting piping.

## 2.5 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Automatic Sprinklers: With heat-responsive element complying with the following:
  1. UL 199, for nonresidential applications.
  2. UL 1767, for early-suppression, fast-response applications.
- C. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- D. Sprinkler types, features, and options as follows:
  1. Concealed ceiling sprinklers, including cover plate.
  2. Extended-coverage sprinklers.
  3. [Flush ceiling sprinklers](#), including escutcheon.
  4. Pendent sprinklers.
  5. Pendent, dry-type sprinklers.
  6. Quick-response sprinklers.
  7. Sidewall sprinklers.
  8. Sidewall, dry-type sprinklers.
  9. Upright sprinklers.
- E. Sprinkler Finishes: Chrome plated and bronze.
- F. Special Coatings: Wax.
- G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
  1. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- H. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

## 2.6 FIRE DEPARTMENT CONNECTIONS

- A. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR."

1. Type: Flush with two inlets and square or rectangular escutcheon plate.
2. Finish: Rough chrome plate

## 2.7 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- C. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

## 2.8 PRESSURE GAGES

- A. Description: UL 393, 3-1/2- to 4-1/2-inch diameter, dial pressure gage with range of 0 to 250 psig.
  1. Water System Piping: Include caption "WATER" on dial face.

## 2.9 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
  1. Standard: ASSE 1013 or AWWA C511.
  2. Operation: Continuous-pressure applications.
  3. Pressure Loss at Design Flow Rate: <Insert psig> or less.
  4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
  5. End Connections: Matching connecting piping for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  6. Configuration: Designed for horizontal, straight through flow.
  7. Backflow preventer shall be fully supported independent of connecting piping.
  8. Accessories:
    - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

## 2.10 VALVE SEALS, TAGS, CHARTS, AND NAMEPLATES

- A. Seals: Brass cross-linked chain, all brass padlocks, and two keys for each manually operated shutoff valve required to be sealed in the open position.

- B. Signs: Provide identification signs of standard design, fastened securely at designated locations in accordance with NFPA 13.
- C. Tags: Provide 2" diameter brass tags, stamped with designation numbers, secured with 12 gauge copper wire to spindle of each valves.
- D. Charts:
  - 1. Provide two copies of the approved "As-Built" sprinkler system diagram and valve chart, giving designated number, function, and location of each valve. Scale of diagram shall be such that it can be easily read.
  - 2. Place one copy behind a clear plastic cover with aluminum frame and locate where directed by the Engineer. Provide the second copy to the Owner.
  - 3. Provide sign below frame: "Sprinkler System Diagram"
- E. Nameplates: Provide permanently marked weatherproof metal or rigid plastic sign secured with corrosion-resistant chain at the base of all risers within the facility. Nameplate shall include the following information:
  - 1. Location of the design area or areas
  - 2. Discharge densities over the design area or areas
  - 3. Required flow and residual pressure demand at the base of the riser
  - 4. Occupancy classification or commodity classification and maximum permitted storage height and configuration
  - 5. Hose stream allowance included in addition to the sprinkler demand
  - 6. Name of the installing contractor.

## 2.11 JOINING MATERIALS

- A. Pipe Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. AWWA C110, rubber, flat face, 1/8 inch thick unless otherwise indicated, and full-face, unless otherwise indicated
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

## 2.12 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.13 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

## 2.14 ESCHUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe and an OD that completely covers opening.
- B. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.
- B. Report test results promptly and in writing.
- C. Fire-hydrant flow data provided within this Specification or the Drawings is provided only for preliminary planning purposes and shall NOT be used as the basis for final design calculations for the system and does not relieve the installer of the requirement to perform a fire hydrant flow test.

### 3.2 PIPING APPLICATIONS, GENERAL

- A. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- B. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

### 3.3 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:
  - 1. NPS 2 and smaller: Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints; or grooved-end, black or galvanized.
  - 2. NPS 2-1/2 to NPS 6: Grooved-end, black, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

### 3.4 VALVE APPLICATIONS

- A. Where specific valve types are not indicated, the following requirements apply:
  - 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13.
    - a. Shutoff Duty: Use butterfly or gate valves.

2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
  - a. Shutoff Duty: Use ball, butterfly, or gate valves.
  - b. Throttling Duty: Use ball or globe valves.

### 3.5 WATER SUPPLY

- A. Connect fire-suppression piping to either the water-service entrance piping or the interior water distribution piping as indicated on the Drawings.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories as needed or indicated on the water supply connection detail.

### 3.6 PIPING INSTALLATION

- A. Locations and Arrangements: Where locations, elevations, or piping schematics are provided on the Drawing, the piping shall be installed as indicated, as far as practical. Bring to the attention of the Engineer any requested or required deviations. Where specific location and arrangement information is not provided:
  1. In areas having ceilings, conceal all pipes.
  2. In storage and service areas, pipe may be exposed but hold to the minimum practicable distance below the ceiling.
- B. Do NOT install piping within the attic or any other un-heated spaces.
- C. Do NOT install piping within exterior walls.
- D. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping free of sags and bends.
- H. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- I. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- J. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections. Flanges are not required in piping installations using grooved joints except for valves, apparatus, and equipment specifically required to utilize a flange connection.
- K. In areas where a future ceiling may be installed, 1 inch minimum outlets shall be provided with hexagonal bushings to accommodate sprinklers attached directly to the branch line to allow for future system modifications. All areas where the distance from the floor to the bottom of the lowest structural member is 15 feet or less shall be considered an area where a future ceiling may be installed unless indicated otherwise by the Engineer in writing.

- L. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- M. Install sprinkler piping with drains for complete system drainage.
- N. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- O. Install alarm devices in piping systems.
- P. Hangers and Supports: Comply with NFPA 13 for hanger materials.
- Q. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.
- R. Install pressure gages on riser or feed main and at each sprinkler test connection. Include pressure gages with connection not less than NPS  $\frac{1}{4}$  and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- S. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Exposed Piping at Wall and Ceiling Penetrations: One-piece, stamped-steel
- T. Sleeves are not required for core-drilled holes.
- U. Install sleeves for pipes passing through interior concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint.
- V. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- W. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- X. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- Y. Fill wet-pipe sprinkler system piping with water.

### 3.7 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40. Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
  - 1. Steel Pipe: Roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.

### 3.8 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
  - 1. Provide identifications tag on each valve.
  - 2. Install permanent identification signs indicating portion of system controlled by each shutoff valve.
  - 3. Install valve seals for all manual shutoff valves required to be sealed in the open position.

### 3.9 SPRINKLER APPLICATIONS

- A. Sprinkler types indicated on Drawings shall be used when provided. Where specific types are not indicated, use the following sprinkler types:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Flush sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Pendent or Sidewall, dry sprinklers.
5. Special Applications: Extended-coverage and quick-response sprinklers when necessitated by occupancy.
6. Sprinkler Finishes:
  - a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
  - b. Flush Sprinklers: Bright chrome, with painted white escutcheon.
7. Sprinkler Protection: Provide wire cage guards on sprinklers subject to physical damage.

### 3.10 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

### 3.11 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire department connections in vertical wall.
- B. Install ball drip valve at each check valve for fire department connection.

### 3.12 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

### 3.13 FIELD TEST REPORTS AND CERTIFICATES

- A. Complete the "Contractor's Material and Test Certificate for Aboveground Piping".
  1. Contractor to fill out all sections of the certificate. "NA" shall be entered in any sections not pertaining to the project.
  2. Contact Engineer at least 48 hours prior to the proposed tests
  3. Provide copies to Engineer and authority having jurisdiction as described in Part 1 of this section.

### 3.14 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

END OF SECTION 211000

**SECTION 230529  
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
1. Steel pipe hangers and supports.
  2. Trapeze pipe hangers.
  3. Metal framing systems.
  4. Thermal-hanger shield inserts.
  5. Fastener systems.
  6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
  2. AWS D1.2, "Structural Welding Code--Aluminum."
  3. AWS D1.3, "Structural Welding Code--Sheet Steel."
  4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

**PART 2 - PRODUCTS**

2.1 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

## 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

## 2.3 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

## 2.4 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## 2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

### **PART 3 - EXECUTION**

#### **3.1 HANGER AND SUPPORT APPLICATIONS**

- A. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- B. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use padded hangers for piping that is subject to scratching.
- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  11. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb .
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
  4. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
  5. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
  6. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

- K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying in building areas constructed to meet the FEMA 361 standards.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and

larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 4: 12 inches long and 0.048 inch thick.
  - 5. Insert Material: Length at least as long as protective shield.
  - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports in building areas constructed to meet the FEMA 361 standards.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

**SECTION 230553**  
**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
  2. Warning signs and labels.
  3. Pipe labels.
  4. Duct labels.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Handwritten identification for HVAC piping and equipment is specifically prohibited.

**PART 2 - PRODUCTS**

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
  2. Letter Color: Black Blue Red White Yellow Insert color.
  3. Background Color: White.
  4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  7. Fasteners: Stainless-steel rivets or self-tapping screws.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number.

## 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Yellow Insert color.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

## 2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Contractor is responsible for labeling pipe, equipment, duct, and valves installed or modified as part of this project.

#### **3.2 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

#### **3.3 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

#### **3.4 PIPE LABEL INSTALLATION**

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Refrigerant Piping:
  - a. Background Color: Green.
  - b. Letter Color: White.

3.5 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  1. Blue: For supply-air ducts.
  2. Yellow: For return-air ducts.
  3. Green: For outside-air ducts.
  4. Red: For exhaust-air ducts.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 230553

**SECTION 230593**  
**TESTING, ADJUSTING, AND BALANCING FOR HVAC**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
1. Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  2. Hydronic Piping Systems:
    - a. Variable-flow systems.
  3. Verifying that automatic control devices are functioning properly.
  4. Reporting results of activities and procedures specified in this Section.

1.2 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- F. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- G. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- H. TAB: Testing, adjusting, and balancing.
- I. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

- J. Test: A procedure to determine quantitative performance of systems or equipment.
- K. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

### 1.3 SUBMITTALS

- A. Qualification Data: Within 45 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Certified TAB Reports: Submit electronic copies of reports prepared, as specified in this Section.

### 1.4 QUALITY ASSURANCE

- A. TAB Firm Qualifications:
  - 1. Certified by AABC, NEBB, or TABB.
  - 2. Minimum TAB experience of 5 years.
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard forms from TAB firm's forms approved by Architect.
- D. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
  - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

### 1.5 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

## **PART 2 - PRODUCTS (Not Applicable)**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine equipment performance data including fan and pump curves.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- E. Examine system and equipment test reports.
- F. Examine HVAC system and equipment installations to verify that indicated balancing devices are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- G. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- H. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- J. Examine equipment for installation and for properly operating safety interlocks and controls.
- K. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.
  - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
  - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
  - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  - 6. Sensors are located to sense only the intended conditions.
  - 7. Sequence of operation for control modes is according to the Contract Documents.
  - 8. Controller set points are set at indicated values.
  - 9. Interlocked systems are operating.
  - 10. Changeover from heating to cooling mode occurs according to indicated values.
- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance, smoke, and fire dampers are open.
  - 5. Isolating and balancing valves are open and control valves are operational.
  - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 7. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", or SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. For variable-air-volume systems, develop a plan to simulate diversity.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.

- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.
- K. Check for proper sealing of air duct system.

### 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure the total supply airflow at the unit using a pitot-tube traverse.
  - 2. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
  - 4. Measure static pressures under final balanced conditions.
  - 5. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
  - 6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
  - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

- a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
  2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  3. Measure total system airflow. Adjust to within indicated airflow.
  4. Measure the total supply airflow at the unit using a pitot-tube traverse.
  5. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
  6. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  7. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
  8. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
  9. Record the final fan performance data.

### 3.7 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

### 3.8 PROCEDURES FOR CONDENSER UNITS

A. Verify proper rotation of fans.

### 3.9 PROCEDURES FOR HEAT-TRANSFER COILS

A. Hydronic Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Fluid inlet and outlet temperatures.

### 3.10 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
6. Capacity: Calculate in tons of cooling.

### 3.11 PROCEDURES FOR PRESSURE CONTROL VALVES

- A. Keep pressure control valves in the fully closed position until the primary pumps have reached their minimum specified pump speed.
- B. Measure the primary loop differential pressure.
- C. Once the primary pumps have reached their minimum specified pump speed, begin to open the pressure control valve to maintain the previously measured primary loop differential pressure setpoint. Measure flow in the primary loop supply and return pipes to ensure they are equal.

### 3.12 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

### 3.13 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
  - 2. Air Outlets and Inlets: 0 to minus 10 percent.
  - 3. Heating-Water Flow Rate: 0 to minus 10 percent.
  - 4. Cooling-Water Flow Rate: 0 to minus 5 percent.

### 3.14 FINAL REPORT

- A. General: Electronic copy in letter-quality font.

- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
  - 1. Pump curves.
  - 2. Fan curves.
  - 3. Manufacturers' test data.
  - 4. Field test reports prepared by system and equipment installers.
  - 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
  - 1. Title page.
  - 2. Name and address of TAB firm.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB firm who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  - 12. Nomenclature sheets for each item of equipment.
  - 13. Notes to explain why certain final data in the body of reports varies from indicated values.
  - 14. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outside-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Fan drive settings including settings and percentage of maximum pitch diameter.
    - e. Inlet vane settings for variable-air-volume systems.
    - f. Settings for supply-air, static-pressure controller.
    - g. Any other system operating conditions that affect performance.
- E. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
  - 1. Unit Data: Include the following:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.

- e. Manufacturer's serial number.
  - f. Unit arrangement and class.
  - g. Discharge arrangement.
  - h. Sheave make, size in inches, and bore.
  - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
  - j. Number of belts, make, and size.
  - k. Number of filters, type, and size.
2. Motor Data:
- a. Make and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm (measured at unit discharge)
- b. Total airflow rate in cfm (summation of air terminals)
- c. Total system static pressure in inches wg.
- d. Fan rpm.
- e. Discharge static pressure in inches wg .
- f. Filter static-pressure differential in inches wg.
- g. Preheat coil static-pressure differential in inches wg.
- h. Cooling coil static-pressure differential in inches wg.
- i. Heating coil static-pressure differential in inches wg.
- j. Outside airflow in cfm.
- k. Return airflow in cfm.
- l. Outside-air damper position.
- m. Return-air damper position.
- n. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Average face velocity in fpm.

- c. Air pressure drop in inches wg.
  - d. Outside-air, wet- and dry-bulb temperatures in deg F.
  - e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - h. Refrigerant expansion valve and refrigerant types.
  - i. Refrigerant suction pressure in psig.
  - j. Refrigerant suction temperature in deg F.
- G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
    - a. System and air-handling unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft..
    - g. Indicated airflow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual airflow rate in cfm.
    - j. Actual average velocity in fpm.
- H. Air-Terminal-Device Reports:
1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Test apparatus used.
    - d. Area served.
    - e. Air-terminal-device make.
    - f. Air-terminal-device number from system diagram.
    - g. Air-terminal-device type and model number.
    - h. Air-terminal-device size.
  2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Preliminary airflow rate as needed in cfm.
    - c. Final airflow rate in cfm.
- I. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Unit make and model number.
    - d. Refrigerant weight in lb.
    - e. Low ambient temperature cutoff in deg F.

2. Test Data (Indicated and Actual Values):
  - a. Entering-air, dry-bulb temperature in deg F.
  - b. Leaving-air, dry-bulb temperature in deg F.
  - c. Control settings.
  - d. Low-pressure-cutout set point in psig.
  - e. High-pressure-cutout set point in psig.
  - f. Suction pressure in psig.
  - g. Suction temperature in deg F.
  - h. Condenser refrigerant pressure in psig.
  - i. Condenser refrigerant temperature in deg F.
  - j. Oil pressure in psig.
  - k. Oil temperature in deg F.
  - l. Voltage at each connection.
  - m. Amperage for each phase.
  - n. Kilowatt input.
  - o. Number of fans.
  - p. Condenser fan rpm.
  - q. Condenser fan airflow rate in cfm.
  - r. Condenser fan motor make, frame size, rpm, and horsepower.
  - s. Condenser fan motor voltage at each connection.
  - t. Condenser fan motor amperage for each phase.

J. Air-to-Air Heat-Recovery Unit Reports:

1. Unit Data:
  - a. Unit identification.
  - b. Location.
  - c. Service.
  - d. Make and type.
  - e. Model and serial numbers.
2. Motor Data:
  - a. Make and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
3. If fans are an integral part of the unit, include the following for each fan:
  - a. Make and type.
  - b. Arrangement and size.
  - c. Sheave make, size in inches, and bore.
  - d. Sheave dimensions, center-to-center, and amount of adjustments in inches.
4. Test Data (Indicated and Actual Values):
  - a. Total exhaust airflow rate in cfm.
  - b. Purge exhaust airflow rate in cfm.
  - c. Outside airflow rate in cfm.
  - d. Total exhaust fan static pressure in inches wg.

- e. Total outside-air fan static pressure in inches wg.
- f. Pressure drop on each side of recovery wheel in inches wg.
- g. Exhaust air temperature entering in deg F.
- h. Exhaust air temperature leaving in deg F.
- i. Outside-air temperature entering in deg F.
- j. Outside-air temperature leaving in deg F.
- k. Calculate sensible and total heat capacity of each airstream in MBh.

K. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.15 INSPECTIONS

A. Initial Inspection:

- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
- 2. Randomly check the following for each system:
  - a. Measure airflow of at least 10 percent of air outlets.
  - b. Measure water flow of at least 5 percent of terminals.
  - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - d. Verify that balancing devices are marked with final balance position.
  - e. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

- 1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Engineer.
- 2. TAB firm test and balance engineer shall conduct the inspection in the presence of Engineer.
- 3. Engineer shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
- 4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- 6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.

7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

END OF SECTION 230593

**SECTION 230700**  
**HVAC INSULATION**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
  - a. Flexible elastomeric.
  - b. Mineral fiber.
2. Adhesives.
3. Mastics.
4. Sealants.
5. Tapes.
6. Securements.

1.2 SUBMITTALS

- A. Product Data: Include thermal conductivity, thickness, and jackets (both factory and field applied) for each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields.
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation

application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## 1.6 SCHEDULING

- A. Schedule insulation application after testing piping systems. Insulation application may begin on segments of piping that have satisfactory test results.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Mineral-Fiber Insulation:
  - a. CertainTeed Manson.
  - b. Knauf FiberGlass GmbH.
  - c. Owens-Corning Fiberglas Corp.
  - d. Schuller International, Inc.

### 2.2 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
  - 1. Preformed Pipe Insulation: Comply with ASTM C547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
  - 2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
    - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
    - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
  - 3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
  - 4. Mineral-Fiber Insulating Cements: Comply with ASTM C195.
  - 5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C196.
  - 6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C499/C 499M.

### 2.3 INTERIOR PIPING INSULATION JACKETS

- A. General: ASTM C921, Type 1, unless otherwise indicated.
- B. Heavy Duty PVC Jackets on all piping within 10ft of finished floor in mechanical room.

- C. Heavy Duty PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- (0.5-mm-) thick, high-impact, ultraviolet-resistant PVC.
  - 1. Shapes: 45- and 90- degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
  - 2. Adhesive: As recommended by insulation material manufacturer.
- D. Factory Applied Jackets: ASJ, white kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type 1.

## 2.4 EXTERIOR PIPING INSULATION JACKETS

- A. General: ASTM C1729, Aluminum-alloy, smooth finish, unless otherwise indicated.
- B. All exterior piping to be provided with Aluminum-Alloy jacketing.
- C. Aluminum-Alloy Fitting Covers: Factory-fabricated fitting covers manufactured from 0.016-inch (0.41-mm-) thick, aluminum-alloy.
  - 1. Shapes: 45- and 90- degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, traps, mechanical joints, and P-trap.
  - 2. Adhesive: As recommended by insulation material manufacturer.

## 2.5 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq.yd.
  - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
  - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
  - 2. Galvanized Steel: 0.005 inch thick.
  - 3. Aluminum: 0.007 inch thick.
  - 4. Brass: 0.010 inch thick.
  - 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

## 2.6 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## 2.7 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

## 2.8 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  - 4. Color: White.

## 2.9 SEALANTS

- A. PVC Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 4. Color: White.

## 2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 11.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

## 2.11 SECUREMENTS

- A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch or 0.135-inch diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch or 0.135-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
4. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Apply insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Use accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Apply multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Apply insulation with least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instruction for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shield over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
  2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- P. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- Q. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- S. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 2. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

### 3.5 MINERAL-FIBER INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 16 inches and smaller, no pins required.
    - b. On duct sides with dimensions larger than 16 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  - 5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 16 inches and smaller, no pins required.

- b. On duct sides with dimensions larger than 16 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- C. Apply insulation to straight pipes and tubes as follows:
  1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
  2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
  3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- D. Apply insulation to flanges as follows:
  1. Apply preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.
- E. Apply insulation to fittings and elbows as follows:
  1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When pre-molded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape or bands.
  3. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
- F. Apply insulation to valves and specialties as follows:

1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When pre-molded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

G. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions 16 inches and smaller, no pins required.
  - b. On duct sides with dimensions larger than 16 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Impale insulation over pins and attach speed washers.
  - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.6 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials and equipment:
1. Flexible connectors.
  2. Vibration-control devices.
  3. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

### 3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor supply and outdoor air.
2. Indoor return air.
3. Indoor, exhaust between isolation damper and penetration of building exterior.
4. Outdoor, supply and return.

B. Items Not Insulated:

1. Factory-insulated flexible ducts.
2. Factory-insulated access panels and doors.

### 3.9 INDOOR DUCT INSULATION SCHEDULE

A. Concealed, Supply Air, round, duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2-1/8 inches thick and 0.75-lb/cu. ft. nominal density..

B. Concealed, Supply Air, rectangular, duct insulation shall be one of the following:

1. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.
2. Mineral-Fiber Blanket: 2-1/8 inches thick and 0.75-lb/cu. ft. nominal density.

C. Concealed, Neutral Air, round and rectangular, duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2-1/8 inches thick and 0.75-lb/cu. ft. nominal density.

D. Concealed, Return Air, round and rectangular, duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2-1/8 inches thick and 0.75-lb/cu. ft. nominal density.

E. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

F. Concealed, Outdoor Air, rectangular, duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. Ft. nominal density.

- G. Mechanical rooms and spaces above ceiling to be considered concealed spaces.

### 3.10 ABOVEGROUND, OUTDOOR DUCT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Exposed, rectangular, duct insulation shall be the following:
  - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

### 3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

### 3.12 INTERIOR PIPING INSULATION SCHEDULE

#### A. Chilled water:

- 1. Operating Temperature: 0 to 100 deg F.
- 2. Insulation Material: Mineral fiber.
- 3. Insulation Thickness: Apply the following insulation thicknesses:
  - a. NPS 1-1/4 and Smaller: 1-1/2 inch thickness.
  - b. NPS 1-1/2 through 12: 2 inch thickness.
- 4. Jacket: PVC, within 10' from the floor level of all mechanical rooms. Factory applied ASJ above 10' from floor level of all mechanical rooms.
- 5. Vapor Retarder Required: Yes.
- 6. Finish: None.

#### B. Refrigerant Suction and Liquid Piping:

- 1. Operating Temperature: -20 to 120 deg F.
- 2. Insulation Material: Mineral fiber.
- 3. Insulation Thickness: 1/2 inch thickness.
- 4. Jacket: PVC, within 10' from the floor level of all mechanical rooms. Factory applied ASJ above 10' from floor level of all mechanical rooms.
- 5. Vapor Retarder Required: Yes.
- 6. Finish: None.

#### C. Heating water:

- 1. Operating Temperature: 0 to 240 deg F.
- 2. Insulation Material: Mineral fiber.
- 3. Insulation Thickness: Apply the following insulation thicknesses:
  - a. NPS 1-1/4 and Smaller: 1-1/2 inch thickness.
  - b. NPS 1-1/2 through 12: 2 inch thickness.

4. Jacket: PVC, within 10' from the floor level of all mechanical rooms. Factory applied ASJ above 10' from floor level of all mechanical rooms.
5. Vapor Retarder Required: Yes.
6. Finish: None.

### 3.13 EXTERIOR PIPING INSULATION APPLICATION SCHEDULE

#### A. Refrigerant Suction and Liquid Piping:

1. Operating Temperature: -20 to 120 deg F.
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: ½ inch thickness.
4. Jacket: Aluminum-Alloy.
5. Vapor Retarder Required: Yes.
6. Finish: None.

### 3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

#### A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

#### B. Ducts and Plenums, Exposed.

1. Aluminum, Smooth: 0.024 inch thick.

#### C. Piping, Exposed:

1. PVC: 30 mils thick.

END OF SECTION 230700

## SECTION 230900 INSTRUMENTATION AND CONTROL FOR HVAC

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes control equipment for HVAC systems and components.
- B. See Drawings for requirements that relate to this Section.

#### 1.2 SUBMITTALS

- A. Product Data: For each control device indicated.
- B. Shop Drawings:
  - 1. Schematic flow diagrams.
  - 2. Power, signal, and control wiring diagrams.
  - 3. Details of control panel faces.
  - 4. Damper schedule.
  - 5. Valve schedule.
  - 6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
  - 7. Control System Software: Schematic diagrams, written descriptions, and points list.
- C. Software and firmware operational documentation.
- D. Field quality-control test reports.
- E. Operation and maintenance data.

#### 1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### 1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
  - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
  - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
  - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.

4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
  - a. Water Temperature: Plus or minus 1 deg F .
  - b. Space Temperature: Plus or minus 0.5 deg F.
  - c. Ducted Air Temperature: Plus or minus 1 deg F.
  - d. Outside Air Temperature: Plus or minus 1 deg F.
  - e. Dew Point Temperature: Plus or minus 1 deg F.
  - f. Relative Humidity: Plus or minus 2 percent.
  - g. Air Pressure (Space): Plus or minus 0.01-inch wg.
  - h. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
9. Countdown Timers: Countdown timers shall be indicated on graphical user interface for any active delay timer used within the control sequence.
10. Sequence Testing Override: A Sequence Testing Override setting shall be provided and accessible to authorized users via password. When enabled, this setting shall cause all input variables to the BAS to be user adjustable. This will allow the Owner to verify and test operation and sequence of equipment. Upon 30 minutes of inactivity, the system shall revert back to normal operational mode.
11. Temperature trending data shall be available for each zone. Data collection rates shall be configurable but shall be initially set to record data once every hour. Sufficient trending data storage shall be provided to allow for a full year's worth of data storage based on initial data sampling rate.
12. User Interface: User interface graphics shall be based on control schematics and plans provided within these bid documents. User interface graphics shall be submitted to the Owner for approval prior to implementation.
13. Control Points: All control points shown on Schematic Control Diagrams Drawings as well as all other control points necessary to provide the sequence of operation shall be incorporated into the graphics. Setpoints and reset schedules shall be adjustable.

## 1.5 NETWORK ARCHITECTURE

- A. Network switches to be installed in locations approved by Owner.

## 1.6 COORDINATION

- A. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with existing Fire Alarm System to achieve compatibility with equipment that interfaces with that system.
- C. All BacNet IP devices will be issued an owner provided IP address and need to be wired back to the Owner's network switch. No unmanaged network switches are permitted to be connected to the network.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 CONTROL SYSTEM

- A. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

### 2.3 DDC EQUIPMENT

A. General

1. The Building Automation System (BAS) shall consist of a Network Server/Controllers (NSC) and a family of Standalone Digital Control Units (SDCUs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility.
2. BAS user interface shall be web-based and the control system server shall be accessed using a web browser over the control system network and the Owner's local area network.
3. No JAVA shall be required to access and view the control system.
4. Systems shall use BACnet communication protocol.
5. BAS devices with wireless access points will not be permitted.
6. Shall be compatible with current Windows version or N-1.
7. All network enabled BAS devices must be IPv4 capable.
8. BAS devices must use wired media in the form of CAT5 or fiber to connect to the Owner's network. No wireless connectivity is permissible.
9. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP protocol.

B. Acceptable Manufacturers:

1. Reliable Controls.

- C. A sub-network of SDCUs using the BACnet IP protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers. All SDCU field controllers shall reside on their own private IP based network and shall communicate back to the NSC. SDCUs shall not require Owner provided IP addresses.

D. Application Software:

1. System security for each operator via software password and access levels.

2. Automatic system diagnostics; monitor system and report failures.
3. Database creation and support.
4. Automatic and manual database save and restore.
5. Dynamic color graphic displays with up to 10 screen displays at once.
6. Custom graphics generation and graphics library of HVAC equipment and symbols.
7. Alarm processing, messages, printing, and reactions.
8. Trend logs retrievable in spreadsheets and database programs.
9. Alarm and event processing.
10. Object and property status and control.
11. Automatic restart of field equipment on restoration of power.
12. Data collection, report printing, and logs. Include standard reports for the following:
  - a. Current values of all objects.
  - b. Current alarm summary.
  - c. Override summary
  - d. Disabled objects.
  - e. Alarm lockout objects.
  - f. Logs.
13. Custom report development.
14. Workstation application editors for controllers and schedules.
15. Maintenance management.

E. Custom Application Software:

1. English language oriented.
2. Full-screen character editor/programming environment.
3. Allow development of independently executing program modules with debugging/simulation capability.
4. Support conditional statements.
5. Support floating-point arithmetic with mathematic functions.
6. Contains predefined time variables.

## 2.4 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
  2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
  3. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

## 2.5 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:
    - a. BEC Controls Corporation.
    - b. Ebtron, Inc.
    - c. Heat-Timer Corporation.
    - d. I.T.M. Instruments Inc.
    - e. MAMAC Systems, Inc.
    - f. RDF Corporation.
  2. Accuracy: Plus or minus 0.5 deg F at calibration point.
  3. Wire: Twisted, shielded-pair cable.
  4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
  5. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
  6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
- C. RTDs and Transmitters:
1. Manufacturers:
    - a. BEC Controls Corporation.
    - b. Ebtron, Inc.
    - c. Heat-Timer Corporation.
    - d. I.T.M. Instruments Inc.
    - e. MAMAC Systems, Inc.
    - f. RDF Corporation.
  2. Accuracy: Plus or minus 0.2 percent at calibration point.
  3. Wire: Twisted, shielded-pair cable.
  4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
  5. Averaging Elements in Ducts: 24 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
  6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
- D. Pressure Transmitters/Transducers:
1. Manufacturers:
    - a. BEC Controls Corporation.
    - b. General Eastern Instruments.
    - c. MAMAC Systems, Inc.
    - d. ROTRONIC Instrument Corp.
    - e. TCS/Basys Controls.
    - f. Vaisala.
  2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
    - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    - b. Output: 4 to 20 mA.
    - c. Building Static-Pressure Range: 0- to 0.25-inch wg.
    - d. Duct Static-Pressure Range: 0- to 5-inch wg.

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
6. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

## 2.6 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- F. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

## 2.7 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
  1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
  3. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
  4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
  5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
  1. Manufacturers:

- a. Belimo Aircontrols (USA), Inc.
  - b. KMC Controls.
  - c. Siemens.
2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
  3. Dampers: Size for running torque calculated as follows:
    - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
    - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
    - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
  4. Coupling: V-bolt and V-shaped, toothed cradle.
  5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
  7. Power Requirements (Two-Position Spring Return): 120-V ac.
  8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
  9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
  10. Temperature Rating: Minus 22 to plus 122 deg F.
  11. Run Time: 12 seconds open, 5 seconds closed.

## 2.8 CONTROL VALVES

### A. Manufacturers:

1. Danfoss Inc.; Air Conditioning & Refrigeration Div.
2. Erie Controls.
3. Hayward Industrial Products, Inc.
4. Magnatrol Valve Corporation.
5. Neles-Jamesbury.
6. Parker Hannifin Corporation; Skinner Valve Division.
7. Pneuline Controls.
8. Sauter Controls Corporation.

### B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

### C. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.

- a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
  - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
4. Sizing: 3-psig maximum pressure drop at design flow rate or the following:
- a. Two Position: Line size.
  - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
  - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- D. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Lug.
  2. Disc Type: Nickel-plated ductile iron.
  3. Sizing: 1-psig maximum pressure drop at design flow rate.
- E. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
  2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
  3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
- F. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
  2. Thermostatic Operator: Liquid-filled remote sensor with remote adjustable dial.

## 2.9 DAMPERS

- A. Manufacturers:
1. Air Balance Inc.
  2. Don Park Inc.; Autodamp Div.
  3. TAMCO (T. A. Morrison & Co. Inc.).
  4. United Enertech Corp.
  5. Vent Products Company, Inc.

- B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
  - 1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze or nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
  - 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
  - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
  - 4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

## 2.10 FLOW METERS

- A. Electronics Enclosure: Weathertight NEMA 4 aluminum enclosure.
- B. Sensing Method: Dual turbine electronic impedance sensing (non-magnetic and non-photoelectric) and frequency averaging circuitry.
- C. Flow Range: 0.1ft/s to 20 ft/s.
- D. Liquid Temperature Range: 15°F to 180°F.
- E. Ambient Temperature Range: -5°F to 160°F.
- F. Wetted Metal Components: Electroless nichel plated brass.
- G. Accuracy: Plus or minus 2 percent of reading from 0.4ft/s to 20ft/s.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
- B. Install locking guards on thermostats in the following locations:
  - 1. Entrances.
  - 2. Corridors.
- C. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

### 3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Connect manual-reset limit controls independent of manual-control switch positions.
- B. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
  - 2. Test and adjust controls and safeties.
  - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
  - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
  - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
  - 6. Test each system for compliance with sequence of operation.
  - 7. Test software and hardware interlocks.
- C. DDC Verification:
  - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
  - 2. Check instruments for proper location and accessibility.
  - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
  - 4. Check instrument tubing for proper fittings, slope, material, and support.
  - 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
  - 6. Check temperature instruments and material and length of sensing elements.
  - 7. Check control valves. Verify that they are in correct direction.
  - 8. Check DDC system as follows:
    - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    - c. Verify that spare I/O capacity has been provided.
    - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

1. The training shall be for a minimum of four hours.
2. The Owner shall provide four maintenance personnel to be trained by the factory-authorized service representative.

END OF SECTION 230900

## SECTION 232113 HYDRONIC PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
1. Hot-water heating piping.
  2. Chilled-water piping.
  3. Makeup-water piping.
  4. Condensate-drain piping.
  5. Blowdown-drain piping.
  6. Air-vent piping.
  7. Safety-valve-inlet and -outlet piping.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of the following:
1. Pressure-seal fittings.
  2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
  3. Air control devices.
  4. Chemical treatment.
  5. Hydronic specialties.
- B. Operation and maintenance data.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
1. Hot-Water Heating Piping: 125 psig at 200 deg F Insert temperature.
  2. Chilled-Water Piping: 125 psig at 200 deg F.
  3. Makeup-Water Piping: 80 psig Insert pressure at 150 deg F.
  4. Condensate-Drain Piping: 150 deg F Insert temperature.
  5. Blowdown-Drain Piping: 200 deg F Insert temperature.
  6. Air-Vent Piping: 200 deg F Insert temperature.
  7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

#### 1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME

label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

## **PART 2 - PRODUCTS**

### **2.1 COPPER TUBE AND FITTINGS**

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    - a. Anvil International, Inc.
    - b. S. P. Fittings; a division of Star Pipe Products.
    - c. Victaulic Company of America.
  - 4. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
  - 5. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
- E. Wrought-Copper Unions: ASME B16.22.

### **2.2 STEEL PIPE AND FITTINGS**

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

- F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
1. Material Group: 1.1.
  2. End Connections: Butt welding.
  3. Facings: Raised face.
- G. Grooved Mechanical-Joint Fittings and Couplings:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    - a. Anvil International, Inc.
    - b. Central Sprinkler Company; a division of Tyco Fire & Building Products.
    - c. National Fittings, Inc.
    - d. S. P. Fittings; a division of Star Pipe Products.
    - e. Victaulic Company of America.
  4. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
  5. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

### 2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

## 2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Hart Industries International, Inc.
  - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
3. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Calpico, Inc.
  - b. Lochinvar Corporation.
3. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

## 2.5 VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements.
2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.

4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements.
2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

C. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements.
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 200 deg F.

## 2.6 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank

for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
4. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- diameter gage glass, and slotted-metal glass guard.

D. In-Line Air Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig.
3. Maximum Operating Temperature: Up to 300 deg F.

2.7 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

2.8 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

C. Test Plugs

1. Manufacturers:
  - a. Winters.
  - b. Petersen.

- c. Watts.
  2. 1/4 inch NPT or 1/2 inch NPT stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
    - a. Neoprene core for temperatures up to 200 degrees F.
    - b. Nordel core for temperatures up to 350 degrees F.
    - c. Viton core for temperatures up to 400 degrees F.
  3. Test Kit:
    - a. Carrying case, internally padded and fitted containing:
      - 1) One 3-1/2 inch diameter pressure gages.
      - 2) One gage adapters with 1/8 inch probes.
      - 3) Two 1-1/2 inch dial thermometers.
- D. Flexible Connectors
  1. Manufacturers:
    - a. Hosecraft.
    - b. Ferguson Enterprises, Inc.
    - c. Zoro.
  2. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 500 psig.
- E. Air Vents
  1. Manufacturers:
    - a. Watts.
    - b. Bell and Gossett.
    - c. Honeywell.
  2. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
  3. Float Type:
    - a. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
  4. Washer Type:
    - a. Brass with hydrosopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.
- F. Strainers
  1. Manufacturers:
    - a. Watts.

- b. Bell and Gossett.
- c. Honeywell.
- 2. Size 2 inch and Smaller:
  - a. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- 3. Size 2-1/2 inch to 4 inch:
  - a. Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- 4. Size 5 inch and Larger:
  - a. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

G. Relief Valves

- 1. Manufacturers:
  - a. Watts.
  - b. Bell and Gossett.
  - c. Zoro.
- 2. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

**PART 3 - EXECUTION**

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
  - 1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
  - 1. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
  - 1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
  - 1. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

- E. Makeup-water piping installed aboveground shall be the following:
  - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and pressure-seal or brazed joints.
- F. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- G. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- H. Air-Vent Piping:
  - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
  - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- I. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

### 3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install throttling-duty valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

### 3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Locate test plugs adjacent to thermometers and thermometer sockets.
- J. Where large air quantities accumulate, provide enlarged air collection standpipes.
- K. Install manual air vents at system high points.
- L. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.
- M. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- N. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- O. Pipe relief valve outlet to nearest floor drain.
- P. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- Q. Install piping to allow application of insulation.
- R. Select system components with pressure rating equal to or greater than system operating pressure.
- S. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- T. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- U. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- V. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- W. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- X. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- Y. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

- Z. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

### 3.4 HANGERS AND SUPPORTS

- A. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  4. Spring hangers to support vertical runs.
- B. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
  2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
  3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
  6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
  7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
- C. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

### 3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install gage taps in piping.
- B. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- D. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.
- E. Coil and conceal excess capillary on remote element instruments.
- F. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- G. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- H. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- I. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- J. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- K. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- L. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
- M. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
  - 1. Install tank fittings that are shipped loose.
  - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

### 3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.

- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

### 3.8 CHEMICAL TREATMENT

- A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

### 3.9 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Do not install hydronic pressure gauges until after systems are pressure tested.
  - 3. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 4. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  - 5. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 6. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
  - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  - 3. Isolate expansion tanks and determine that hydronic system is full of water.
  - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.
  - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
  - 1. Open manual valves fully.
  - 2. Inspect pumps for proper rotation.
  - 3. Set makeup pressure-reducing valves for required system pressure.

4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

**SECTION 233113**  
**METAL DUCTS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
1. Single-wall rectangular ducts and fittings.
  2. Single-wall round ducts and fittings.
  3. Sheet metal materials.
  4. Sealants and gaskets.
  5. Hangers and supports.

1.2 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 – “Systems and Equipment” and Section 7 – “Construction and System Start-up.”
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 – “HVAC System Construction and Insulation.”

1.3 PERFORMANCE REQUIREMENTS

- A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.
1. Static-Pressure Classes:
    - a. Supply Ducts (except in Mechanical Rooms): 1-inch wg.
    - b. Return Ducts (Negative Pressure): 1-inch wg.
    - c. Exhaust Ducts (Negative Pressure): 2-inch wg.
  2. Leakage Class:
    - a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
    - b. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg .
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

## PART 2 - PRODUCTS

### 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Fabricate round ducts larger than 90 in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.

## 2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Tape Width: 4 inches.
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 7. Service: Indoor and outdoor.
  - 8. Service Temperature: Minus 40 to plus 200 deg F.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

## 2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

### **PART 3 - EXECUTION**

#### **3.1 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

#### **3.2 SEAM AND JOINT SEALING**

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

#### **3.3 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.4 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

### 3.5 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.
- B. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
    - a. Velocity 1000 fpm or Lower:
      - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - b. Velocity 1000 to 1500 fpm:
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
    - c. Velocity 1500 fpm or Higher:
      - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

- 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
  - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- C. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.
    - b. Rectangular Main to Round Branch: High efficiency takeoff with gasket.
  2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals."
    - a. Velocity 1000 fpm or Lower: 90-degree tap.
    - b. Velocity 1000 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

**SECTION 233300**  
**AIR DUCT ACCESSORIES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
1. Manual volume dampers.
  2. Flange connectors.
  3. Turning vanes.
  4. Duct-mounted access doors.
  5. Flexible connectors.
  6. Flexible ducts.
  7. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

**PART 2 - PRODUCTS**

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G90.
  2. Exposed-Surface Finish: Mill phosphatized.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.2 MANUAL VOLUME DAMPERS

### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow LLC.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Pottorff; a division of PCI Industries, Inc.
8. Ruskin Company.
9. Trox USA Inc.
10. Vent Products Company, Inc.

### B. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating.
2. Suitable for horizontal or vertical applications.
3. Frames:
  - a. Hat-shaped, galvanized steel channels, 0.064-inch minimum thickness.
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
  - a. Multiple or single blade.
  - b. Parallel-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized-steel, 0.064 inch thick.
5. Blade Axles: Galvanized steel.
6. Bearings:
  - a. Synthetic.
  - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
7. Tie Bars and Brackets: Galvanized steel.

### C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

## 2.3 FLANGE CONNECTORS

### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

#### 2.4 TURNING VANES

- A. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- C. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

#### 2.5 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
    - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

#### 2.6 FLEXIBLE CONNECTORS

- A. Materials: Flame-retardant or noncombustible fabrics.

- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd.
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.

## 2.7 FLEXIBLE DUCTS

- A. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
  - 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 175 deg F.
- B. Flexible Duct Connectors:
  - 1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

## 2.8 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. At maximum 50-foot spacing.
  - 2. Upstream of turning vanes.
  - 3. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes: (install the largest size below based on the ductwork size)
  - 1. Hand Access: 6 by 10 inches.
  - 2. Head and Hand Access: 12 by 12 inches.
  - 3. Head and Shoulders Access: 18 by 18 inches.
- J. Install flexible connectors to connect ducts to equipment with an airflow over 2000 cfm.
- K. Connect diffusers to low-pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- L. Install duct test holes where required for testing and balancing purposes.

END OF SECTION 233300

## SECTION 233423 HVAC POWER VENTILATORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Ceiling exhaust fans.

#### 1.2 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B. AMCA 99 - Standards Handbook; 2025.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.
- E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

#### 1.3 SUBMITTALS

- A. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- B. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Carnes, a division of Carnes Company Inc.
- B. Greenheck Fan Corporation.
- C. Loren Cook Company.
- D. PennBarry, Division of Air System Components.
- E. Ruck Air Movement Inc.

- F. Twin City Fan & Blower.

## 2.2 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: Comply with AMCA 204.
- B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- D. Fabrication: Comply with AMCA 99.
- E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

## 2.3 CEILING EXHAUST FANS

- A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resiliently mounted motor, gravity backdraft damper in discharge.
- B. Grille: Molded white plastic.
- C. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is reached with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- D. Performance Ratings: As indicated on drawings.

## **PART 3 EXECUTION**

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide backdraft dampers on outlet from cabinet and ceiling exhausters fans and as indicated.

END OF SECTION 233423

**SECTION 233713  
DIFFUSERS, REGISTERS, AND GRILLES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

**PART 2 - PRODUCTS**

2.1 GRILLES AND REGISTERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - 1. Krueger HVAC.
  - 2. Nailor Industries of Texas Inc.
  - 3. Price Industries.
  - 4. Titus.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

**SECTION 237313**  
**MODULAR INDOOR CENTRAL STATION AIR HANDLING UNITS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
1. Constant-air-volume, single-zone air-handling units.

1.2 SUBMITTALS

- A. Product Data: For each air-handling unit indicated.
1. Unit dimensions and weight.
  2. Cabinet material, metal thickness, finishes, insulation, and accessories.
  3. Fans:
    - a. Certified fan-performance curves with system operating conditions indicated.
    - b. Certified fan-sound power ratings.
    - c. Fan construction and accessories.
    - d. Motor ratings, electrical characteristics, and motor accessories.
  4. Certified coil-performance ratings with system operating conditions indicated.
  5. Filters with performance characteristics.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. Comply with NFPA 70.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Air Enterprises, Inc.
2. Airtherm; a Mestek company.
3. Buffalo Air Handling.
4. Carrier Corporation; a member of the United Technologies Corporation Family.
5. Coil Company, LLC.
6. Dunham-Bush, Inc.
7. Engineered Air.
8. Mammoth Inc.
9. McQuay International
10. Scott Springfield Mfg. Inc.
11. Trane; American Standard Inc.
12. USA Coil & Air.
13. YORK International Corporation.

## 2.2 UNIT CASINGS

### A. General Fabrication Requirements for Casings:

1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
2. Casing Joints: Sheet metal screws or pop rivets.
3. Sealing: Seal all joints with water-resistant sealant.
4. Factory Finish for Steel and Galvanized-Steel Casings: Apply manufacturer's standard primer immediately after cleaning and pretreating.
5. Unit Cabinet: Galvanized steel, with minimum thickness of 20-gauge.

### B. Casing Insulation and Adhesive:

1. Cabinet Insulation: Fiberglass with immobilized EPA registered anti-microbial acrylic coating.
  - a. Insulation adhesive: Comply with NFPA 90A for flame spread and smoke generation.
2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the coil section.
  - a. Liner Adhesive: Comply with ASTM C 916, Type I.
  - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
  - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service-air velocity.
3. Location and Application: Encased between outside and inside casing.

### C. Inspection and Access Panels and Access Doors:

1. Panel and Door Fabrication: Formed and reinforced, single- or double-wall and insulated panels of same materials and thicknesses as casing.
2. Inspection and Access Panels:

- a. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
  - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
  - c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
3. Locations and Applications:
- a. Fan Section: Inspection and access panel.
  - b. Coil Section: Inspection and access panel.
- D. Condensate Drain Pans:
1. Fabricated with slopes in at least 2 planes to collect condensate from cooling coils (including coil piping connections, coil headers and return bends).
  2. Single-wall, galvanized-steel sheet.
  3. A minimum of 2 inches deep, and complying with requirements in ASHRAE 62.1.
  4. Drain Connections: Both ends of pan with NPS 1 threaded nipple.
  5. Pan-Top Surface Coating: Asphaltic waterproofing compound.
  6. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- ### 2.3 FAN, DRIVE, AND MOTOR SECTION
- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.
    - a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
    - b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
1. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  2. Horizontal-Flanged, Split Housing: Bolted construction.
  3. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector.
  4. Internally isolated with rubber grommets.
- C. Forward-Curved, Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.
- D. Fan Shaft Bearings:
1. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with a rated life of 120,000 hours according to ABMA 9.

- E. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.2 service factor based on fan motor.
  - 1. Pulleys: Cast iron or cast steel with split tapered bushing; dynamically balanced at factory.
  - 2. Motor Pulleys: Adjustable pitch. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
  - 3. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple-belt drives.
  - 4. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.1046-inch- thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.

## 2.4 COIL SECTION

### A. General Requirements for Coil Section:

- 1. Comply with ARI 410.
- 2. Coils shall not act as structural component of unit.

### B. Water Heating and Cooling Coils

- 1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
- 2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

### C. Electrical Heating Coils, Controls, and Accessories: Comply with UL 1995.

- 1. Casing Assembly: Galvanized-steel frame.
- 2. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
- 3. Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.
- 4. Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
- 5. Control Panel: Unit mounted with disconnecting means and overcurrent protection.
  - a. Pilot light.
  - b. Airflow proving switch.
  - c. Capacity modulation on a 0 to 10 Vdc or 4 to 20 mA control signal.

## 2.5 AIR FILTRATION SECTION

### A. General Requirements for Air Filtration Section:

- 1. Comply with NFPA 90A.
- 2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
- 3. Provide filter holding frames arranged for flat or angular orientation. Filters shall be removable from one side or lifted out from access plenum.

### B. Disposable Panel Filters:

1. Factory-fabricated, viscous-coated, flat-panel type.
2. Thickness: 1 inch.
3. Merv (ASHRAE 52.2): 8.
4. Media: Interlaced glass fibers sprayed with nonflammable adhesive.

## 2.6 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Equipment Mounting: Install air-handling unit using elastomeric mounts.
- B. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- D. Drawings indicate general arrangement of piping, fittings, and specialties.
- E. Install piping adjacent to air-handling unit to allow service and maintenance.
- F. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- G. Connect condensate drain pans using schedule 40 PVC. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- H. Hot- and Chilled-Water Piping: Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- I. Connect duct to air-handling units with flexible connections.

END OF SECTION 237313

**SECTION 239100**  
**LOUVERS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes fixed and operable louvers, frames and accessories.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc.:
  - 1. AMCA 500- L - Test Methods for Louvers, Dampers, and Shutters.
- B. Underwriters Laboratories Inc.:
  - 1. UL - Electrical Construction Equipment Directory.
- C. Federal Emergency Management Agency:
  - 1. FEMA 361 – Safe Rooms for Tornadoes and Hurricanes.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames and wiring diagrams.
- B. Product Data: Submit data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with AMCA Certification for Water Penetration, Air Performance, and Wind Driven Rain, in compliance with AMCA 500-L. Attach AMCA seal to louvers.
- B. Perform Work in accordance with specified building codes and manufacturer standards.

1.5 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.6 COORDINATION

- A. Coordinate Work with installation of masonry flashings and other building finishing materials.

- B. Coordinate Work with installation of mechanical ductwork and electrical services to motorized devices.

## **PART 2 - PRODUCTS**

### **2.1 WALL LOUVERS - DRAINABLE STYLE**

#### **A. Manufacturers:**

1. Air Balance Inc.; A Division of Mestek Inc.
2. Air Flow Company Inc.
3. Airolite Company, LLC
4. All-Lite Architectural Products
5. American Warming and Ventilating
6. Arrow United Industries
7. Larnes Company
8. Cesco Products; A Division of Mestek, Inc.
9. Construction Specialties, Inc.
10. Dams Incorporated; D. Architectural Metal Solutions Incorporated
11. Greenheck Fan Corporation
12. Industrial Louvers Inc.
13. Louvers & Dampers, Inc.
14. Metal Form Manufacturing
15. NCA Manufacturing Inc.
16. Nystrom, Inc.
17. Pottorff
18. Reliable Products, Inc.
19. Ruskin Company
20. Safe-Air Dowco Products
21. United Enertech
22. Vent Products Company, Inc.

B. Louver Construction: Aluminum.

C. Louver Panel Thickness: as indicated in Drawings.

D. Louver Blade Design: Sloped at 45 degrees; dual drain style.

E. Louver: To permit a minimum of 40 percent free area.

F. Water Penetration: Not more than 0.01 oz/sq ft of free area at minimum 500 ft / min face velocity.

### **2.2 ACCESSORIES**

A. Fasteners and Anchors: Stainless steel type.

B. Primer: Zinc chromate, alkyd type.

C. Flashings: Of same material as louver frame.

D. Provide louvers with backdraft dampers where indicated on Drawings.

- E. Provide louvers with actuated dampers where indicated on Drawings. Actuated dampers to be connected by a common damper linkage and manufacturer installed damper actuator.

## 2.3 FABRICATION

- A. Louver Blade Design: Slope and style as specified for each louver type; reinforced with intermediate stiffeners.
- B. Louver Frame: Mechanically fastened or welded corner joints. Form perimeter of frames with recessed channel to retain backer rod for sealant application.
- C. Screens: Install screen mesh in shaped frame, reinforce corner construction.

## 2.4 FACTORY FINISHING

- A. Exterior Aluminum Surfaces, Screens and Blank-Out Sheeting: Mill finish. Coordinate color with Architect.
- B. Interior Aluminum Surfaces and Blank Out Sheeting: Unfinished.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Verify prepared openings and flashings are ready to receive Work and opening dimensions are as indicated on shop drawings.
- B. Verify electric power is available and of correct characteristics.

### 3.2 INSTALLATION

- A. Install louvers level and plumb.
- B. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- C. Secure louvers in opening framing with concealed fasteners, removable or hinged for maintenance purposes.
- D. Install insect screen and frame to interior of louver.
- E. Install Work in accordance with manufacturer's instructions.

### 3.3 ADJUSTING

- A. Adjust operable louvers for freedom of movement of control mechanism. Lubricate operating joints.

3.4 CLEANING

- A. Clean surfaces and components.

END OF SECTION 239100

**SECTION 260519**  
**LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

**PART 2 - PRODUCTS**

2.1 STANDARDS

- A. Insulation types, ratings and usage shall be in accordance with the National Electrical Code requirements.
- B. All conductors shall be copper
- C. Unless otherwise noted, minimum wire size for lighting and power branch circuits shall be No. 12 AWG. For control and auxiliary systems the minimum size shall be No. 14 AWG.

2.2 CONDUCTORS AND CABLES

- A. All wire and cable shall be UL listed.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW, and SO.
  - 1. THHN-THWN and XHHW: 90 degree C temperature rating in dry or wet locations.

- D. Multiconductor Cable: Comply with NEMA WC 70 for metal clad cable, Type MC and Type SO with ground wire.

### 2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- B. All components used at wiring terminations, connections and splices shall be UL listed.

## **PART 3 - EXECUTION**

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway or Type XHHW, single conductors in raceway.
- B. Feeders and Branch Circuits: Type THHN-THWN, single conductors in raceway.
- C. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- D. Concealed light fixture whips: Metal clad cable (Type MC) limited to six feet in length.
- E. Existing walls and ceilings requiring fishing of cable between access points: Metal clad cable (Type MC).
- F. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- G. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- F. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- G. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

END OF SECTION 260519

**SECTION 260526**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.
- B. Grounding system shall be in compliance with all requirements of the National Electrical Code.

1.2 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

**PART 2 - PRODUCTS**

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.

- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 5/8 inch in diameter by 10 feet or as noted on the Drawings.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 EQUIPMENT GROUNDING

- A. A separate equipment grounding conductor, minimum size per NEC, shall be installed in each feeder, branch circuit, and control circuit conduit. Conductor insulation shall be green. DO NOT use conduit as a means for grounding of receptacles or any other such devices.
- B. Conduit system shall be electrically continuous. All enclosures and non-current carrying metals to be grounded. All locknuts must cut through enameled or painted surfaces on enclosures. Where enclosures and non-current carrying metals are isolated from the conduit system, use bonding jumpers with approved clamps.
- C. All new receptacles shall be bonded to a ground conductor using a #12 AEG min. bonding jumper between receptacle terminal and ground conductor. Metal-to-metal contact between the device yoke and the outlet box is not acceptable for either surface mounted boxes or flush type boxes.
- D. Junction boxes and pull boxes shall be bonded by the use of UL listed ground screws or lugs.
- E. Lighting fixtures shall be grounded by the use of a pigtail fastened on bare metal that is free of paint.
- F. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

- G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

### 3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- C. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

END OF SECTION 260526

**SECTION 260529  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes:
  - 1. Hangers and supports for electrical equipment and systems.

1.2 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.

**PART 2 - PRODUCTS**

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
    - g. Wesanco, Inc.
  - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 2. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
  - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  - 5. Toggle Bolts: All-steel springhead type.
  - 6. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

**SECTION 260533**  
**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

**PART 2 - PRODUCTS**

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. EMT: ANSI C80.3.
- C. FMC: Zinc-coated steel.
- D. LFMC: Flexible steel conduit with PVC jacket.
- E. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Fittings for EMT: Steel, compression type. Die cast fittings are not acceptable.
- F. LFMC: Flexible steel conduit with PVC jacket. Made from a continuous length of galvanized cold rolled steel strip, spirally wound. Adjacent strips shall have locked typed construction with all the edges turned in. With an extruded PVC jacket.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. PVC conduit shall be heavy wall, Schedule 40 ultra-violet resistant, UL listed under Standard 651. Conduit shall be suitable for use with 90 degree C insulated wire. Conduit fittings and cement shall be of the same manufacturer.
- B. Fittings for Schedule 40 PVC: Match to conduit or tubing type and material.

## 2.3 BOXES AND ENCLOSURES

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1,
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

## 2.4 SLEEVES FOR RACEWAYS

- A. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
  - 1. Exposed Conduit: Rigid Steel Conduit.
  - 2. Concealed Conduit: EMT.
  - 3. Underground Conduit: Schedule 40 PVC, direct buried.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. All other exposed areas: RMC.
  - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC
  - 5. Damp or Wet Locations: RMC.
  - 6. Raceways for Optical Fiber or Communications Cable: EMT.
  - 7. Boxes and Enclosures: NEMA 250, Type 1, or as required for environmental conditions expected.
- C. Minimum Raceway Size: 3/4-inch trade size Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

### 3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. In finished areas, conduit must be concealed above accessible ceilings, within the building structure, or within chases. Exposed conduits to be run tight to wall or ceiling and installed in a neat workmanlike manner, ready for painting.
- C. Install conduit parallel or perpendicular to building lines (except where run in or below floor slabs). Keep conduit runs as closed to underside of structure as possible.
- D. Exercise necessary precautions to prevent accumulation of water, dirt, or concrete in conduits during execution of electrical work. Conduit in which water or foreign material has been permitted to accumulate shall be thoroughly cleaned, or replaced where such accumulations cannot be removed.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- H. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- I. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- J. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- K. Raceways below slabs:
  1. Minimum conduit size shall be 1".
  2. Change from PVC conduit to rigid steel conduit before rising above floor.
- L. Raceway below grade: Install warning tape a minimum of six (6) inches below grade and not less than twelve (12) inches above the raceway.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 240-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- O. Raceways for Optical Fiber and Communications Cable: Install as follows:
  1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
  2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.

3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- P. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where otherwise required by NFPA 70.
- Q. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
- R. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
1. Wall boxes in tile, marble, brick or other finished masonry wall shall be of welded construction and designed for installation within masonry.
- S. Set metal floor boxes level and flush with finished floor surface.
- T. Metal boxes cast in concrete shall be designed for concrete installation.
- U. Weather-proof boxes shall be die cast aluminum.
- V. Boxes for exposed work in finished area to be Type FS with threaded hubs and rigid conduit risers.
- W. Install expansion fittings at all locations where conduits cross building expansion joints.
- X. Secure rigid conduit at cabinets and boxes using insulated throat type grounding and bonding bushings. Locknuts shall be tightened to cut through painted surfaces.
- Y. Where a number of conduits are to be run exposed and parallel, one with another, they shall be grouped and supported by trapeze hangers or unistrut racks tight to the building structure.
- Z. Mount junction and pull boxes securely to building structure in a location that meets the requirements of the National Electrical Code for accessibility and work space clearance. Coordinate exact locations of work with other trades. Unless noted otherwise, mounting heights shall be (all measurements are to the top of the box):

Switches, receptacles, or telephone/data shown above a countertop	12" above countertop
Dedicated receptacles (i.e. refrigerator, microwave, etc.)	To suit equipment (see equipment/cabinetry elevation drawings where applicable)
Other interior receptacles	16" AFF
Exterior receptacles	20" above finished grade

Other switches	48" AFF
Telephone/data shown next to a doorway	56" AFF
Other telephone/data	16" AFF

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials.
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION 260533

**SECTION 260553**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Identification for conductors and communication and control cable.
  - 2. Data/Telephone outlet labels
  - 3. Receptacle labels
  - 4. Warning labels and signs.
  - 5. Instruction signs.
  - 6. Equipment identification labels.
  - 7. Miscellaneous identification products.

1.2 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.145.

1.3 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

**PART 2 - PRODUCTS**

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 DATA/TELEPHONE OUTLET LABELS

- A. Machine printed paper insert with black filled lettering located under clear label cover on face of plate and durable wire markers on inside of outlet box.

### 2.3 RECEPTACLE LABELS

- A. Hot stamped machine printing with black filled lettering on clear background on face of plate and durable wire markers on inside of outlet box.

### 2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Color Scheme
  - 1. Emergency Warning labels: White background with red letters
  - 2. All other warning labels: Yellow background with black letters
- D. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
  - 3. Junction boxes containing emergency circuits: "EMERGENCY CIRCUITS- PANEL *insert name*"
  - 4. As noted on drawings.

### 2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face. (White letters on red background for emergency information)
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

### 2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for fasteners, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Fasteners for Labels: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

### 2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

- B. Covers for all junction boxes containing emergency circuits shall be red.

### **PART 3 - EXECUTION**

#### **3.1 APPLICATION**

- A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.
  2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
- B. Data/Telephone Outlet Identification: Use outlet labels to identify each outlet connection. Use system of designation that is uniform and consistent with cable identification. Label face of plate and wire markers inside of box,
- C. Receptacle Identification: Use labels to identify panelboard and circuit number from which served. Label face of plate and wire markers inside of box,
- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
  2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- E. Instruction Signs:
1. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters.
- F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
    - a. Indoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment. Unless otherwise indicated, provide a single line of text with

1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.

- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
- c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

- a. New panelboards, electrical cabinets, and enclosures.
- b. Inverters
- c. Disconnect switches.
- d. Contactors.
- e. Timeclocks
- f. Fire alarm control panel and annunciators
- g. Motor control switches including Hand/Off/Auto switches

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded feeder, and branch-circuit conductors.
  - 1. Color shall be factory applied or for sizes larger than No. 10 AWG field applied
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 3. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
  - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION 260553

**SECTION 260923**  
**LIGHTING CONTROL DEVICES**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
  - 1. Wall-box occupancy sensors
  - 2. Ceiling Mounted occupancy sensors.
  - 3. Emergency shunt relays.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Interconnection diagrams showing field-installed wiring.
- B. Shop Drawings: For each lighting switching schematic shown in the Drawings, provide a separate wiring diagram with wire types, quantities, and devices necessary to provide the functionality indicated on the drawings. Generic wiring diagrams will not be acceptable.
- C. Operation and Maintenance Data: Provide an electronic copy, include the following:
  - 1. Operating Instructions
  - 2. Wiring diagrams
  - 3. As-built settings

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

## **PART 2 - PRODUCTS**

### 2.1 WALL BOX OCCUPANCY SENSOR

- A. See schedule on Drawings

### 2.2 INDOOR CEILING MOUNT OCCUPANCY SENSORS

- A. See schedule on Drawings
- B. General Description: Ceiling-mounting, solid-state units with a separate relay unit.
  - 1. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
  - 2. Control: Occupancy and Vacancy sensors shall provide a 24V output signal to the energy recovery unit.

### 2.3 EMERGENCY SHUNT RELAY

- A. See schedule on Drawings

## **PART 3 - EXECUTION**

### 3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

END OF SECTION 260923

## **SECTION 262726 WIRING DEVICES**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Cord and plug sets.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

#### 1.5 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

## 2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 5351 (single), 5352 (duplex).
    - b. Hubbell; HBL5351 (single), CR5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5381 (single), 5352 (duplex).
- B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; TRBR20.
    - b. Hubbell; BR20TR.
    - c. Leviton; TCR20

## 2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; GF20.
    - b. Pass & Seymour; 2084.

## 2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.5 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Thermoplastic nylon, white
  3. Material for Unfinished Spaces: Thermoplastic Nylon or Galvanized steel.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

## 2.6 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
  1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
  2. Wiring Devices Connected to Emergency Power System: Red.

## **PART 3 - EXECUTION**

### 3.1 RECEPTACLE APPLICATION

- A. In all areas accessible to students: Tamper Resistant receptacles
- B. In areas not accessible to students: Standard receptacles
- C. Where required by the most recent version of the NEC and as indicated on the plan sheets: GFCI receptacles

### 3.2 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

END OF SECTION 262726

**SECTION 262816**  
**ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
1. Fusible switches.
  2. Nonfusible switches.
  3. Enclosures.

1.2 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
1. Enclosure types and details for types other than NEMA 250, Type 1.
  2. Current and voltage ratings.
  3. Short-circuit current rating.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.4 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 FUSIBLE AND NONFUSIBLE SWITCHES

### A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Square D/Group Schneider.
4. Siemens

### B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type Heavy Duty, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

### C. Non-fusible Switch, 600 A and Smaller: NEMA KS 1, Type Heavy Duty Duty, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

### D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors. ( If required)

## 2.3 ENCLOSURES

### A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. As noted in the drawings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

### 3.3 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816

## **SECTION 265100 INTERIOR LIGHTING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Interior lighting fixtures.
  - 2. Exit signs.
  - 3. Lighting fixture supports.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of lighting fixture including dimensions.
  - 2. Emergency lighting units including battery and charger.
  - 3. Energy-efficiency data.
  - 4. Life, output, and energy-efficiency data for lamps.

#### **1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

#### **1.5 COORDINATION**

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. See lighting schedule on Drawings.

### **2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS**

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

### **2.3 EXIT SIGNS**

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  - 1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
  - 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    - f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

### **2.4 LIGHTING FIXTURE SUPPORT COMPONENTS**

- A. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
  - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- C. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Adjust aimable lighting fixtures to provide required light intensities.

#### **3.2 FIELD QUALITY CONTROL**

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

END OF SECTION 265100

**SECTION 283111**  
**DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Smoke Detectors
3. Heat Detectors
4. Input Modules
5. Relay Modules
6. Manual fire-alarm boxes.
7. Notification appliances.
8. Magnetic door holders.
9. Wire and Cable.

1.2 SYSTEM DESCRIPTION

A. Project generally consists of the following:

1. New fire alarm devices in the proposed building addition.
2. Connection of the proposed fire alarm system for the new Middle School wing to the existing fire alarm system in the existing Middle/High School building to the west of the proposed building and to the Intermediate School to the east of the proposed building such that activation of the fire alarm in either of the existing buildings or the proposed buildings will activate the fire alarm notification devices in all three buildings.

B. Non-coded, UL Listed intelligent analog addressable system, one-way voice communications with multiplexed signal transmission and survivable network nodes

C. The system is based upon design using high fidelity speaker to provide voice evacuation instructions. Speakers will also be adjusted in the field by the contractor as necessary for the installation.

D. The voice communications system shall have minimum of 12 programmable voice messages and selectable switches at the control panel and LOC/Annunciator for:

1. Evacuation
2. Soft Lock Down
3. Hard Lock Down
4. Severe Weather
5. Take Shelter
6. Test Message
7. All Clear
- 8-12 Future

- E. Fire alarm contractor shall coordinate with Owner during the shop drawing review process to determine the information to be provided in each voice message.
- F. Provide the following specialty manual stations within the existing Middle School office to automatically activate a pre-recorded message:
  - 1. BLUE Manual Station – Lock Down
  - 2. YELLOW Manual Station – Severe Weather
- G. The fire alarm equipment and installation shall comply with the current provisions of the following latest edition standards and shall be listed for its intended purpose and be compatibility listed to ensure integrity of the complete system.

### 1.3 BUILDING CODES and STANDARDS

- A. National Fire Protection Association (NFPA):
  - 1. NFPA-70 National Electrical Code (NEC)
  - 2. NFPA-72 National Fire Alarm Code
  - 3. NFPA 101 Life Safety Code
  - 4. IBC International Building Code
  - 5. IFC International Fire Code
  - 6. IMC International Mechanical Code
- B. National Electrical Manufacture's Association (NEMA)
- C. Underwriters Laboratories, Inc. (UL)
  - 1. UL-864 Control Units for Fire Protective Signaling Systems (9<sup>th</sup> Edition)
  - 2. UL-268 Smoke Detector for Fire Protective Signaling Systems
  - 3. UL-217 Smoke Detectors for Single and Multiple Station
  - 4. UL-521 Heat Detectors for Fire Protective Signaling Systems
  - 5. UL-464 Audible Signaling Appliances
  - 6. UL-1971 Visual Signaling Appliances
  - 7. UL-38 Manually Actuated Signaling Boxes
  - 8. UL-1481 Power Supplies for Fire Protective Signaling Systems
  - 9. UL 2017 Mass Notification Systems
  - 10. UL 2572 Control and Communication Units for Mass Notification Systems

### 1.4 SUBMITTALS

- A. General Submittal Requirements:
  - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
  - 2. Shop Drawings shall be prepared by persons with the following qualifications:
    - a. Trained and certified by manufacturer in fire-alarm system design.
    - b. NICET-certified fire-alarm technician, Level II minimum.
- B. Product Data: For each type of product indicated.

- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
  2. Include voltage drop calculations for notification appliance circuits.
  3. Include battery-size calculations. Batteries shall be upsized 25% from minimum requirements derived from calculations.
  4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  5. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
  6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits from end-to-end. "Home Run" indicators or other non end-to-end wire path designations are not acceptable.
- D. Field quality –control reports.
- E. Demonstration Training Sign-In Sheet
1. Sign in sheet with all attendee's signature from demonstration training for Owner
- F. Operation and Maintenance Data: For fire-alarm systems and components. Provide (3) hard copies in separate 3-ring binders and an electronic copy. Include the following:
1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72.
  2. Provide "Record of Completion Documents" according to NFPA72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
  3. Record copy of site-specific software database file, hardcopy printout and CD, with password for delivery to the owner. Proprietary system/service companies will not be acceptable.
  4. Provide "Maintenance, Inspection and Testing Records" according to NFPA72 article of the same name and include the following:
    - a. Frequency of testing of installed components.
    - b. Frequency of inspection of installed components.
    - c. Requirements and recommendations related to results of maintenance.
  5. Manufacturer's required maintenance related to system warranty requirements.
  6. Abbreviated operating instructions for mounting at fire-alarm control unit.

## 1.5 SEQUENCING AND SCHEDULING

- A. Existing fire alarm systems with the existing Middle/High School and the Intermediate School shall be fully operational whenever students and/or faculty are present in the building. Fire alarm outages to facilitate integration with new fire alarm system shall be coordinated with the Owner and cannot occur when the building is occupied by students or teachers.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Federal Signal Corporation.
  - 2. Fire Lite Alarms; a Honeywell company.
  - 3. NOTIFIER; a Honeywell company.
  - 4. Siemens Building Technologies, Inc.; Fire Safety Division.
  - 5. Silent Knight; a Honeywell company.
  - 6. SimplexGrinnell LP; a Tyco International company.
- B. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling fire alarm system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- C. The Contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these Specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.

### 2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Mass Notification initiated event shall override any event and take the highest system priority.
- B. Fire-alarm signal initiation shall be by one or more of the following devices:
  - 1. Manual stations.
  - 2. Heat detectors.
  - 3. Smoke detectors.
  - 4. Automatic sprinkler system water flow.
- C. Fire-alarm signal shall initiate the following actions:
  - 1. Activate multiple channel pre-recorded voice messages followed by temporal tone.
  - 2. Continuously operate alarm notification appliances.
  - 3. Identify alarm at fire-alarm control unit and remote annunciators.
  - 4. Transmit an alarm signal to the remote alarm receiving station.

5. Release fire and smoke doors held open by magnetic door holders.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Activate emergency lighting control.

D. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.

E. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

F. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

### 2.3 FIRE-ALARM CONTROL UNIT

A. The main control panel or remote control panel(s) shall be a multi-processor based networked system designed specifically for detection, and one-way emergency audio communications applications. The control panel(s) shall be listed and approved for the application under the standard(s) as listed.

B. The control panel(s) shall include all required hardware, software and site-specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any application can be configured, and modified using software provided by a single supplier. The control panel operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

C. The network of control panels shall include the following features.

1. Each control panel (network node) shall have an LCD display with common controls. The display shall be configurable to display the status of any and all combinations of alarm, supervisory, trouble, monitor, or group event messages.
2. From each LCD display on the system shall be capable of being programmed for control functions of any node or the entire network. The LCD display shall reside on the network as a node and continue to operate with fault on the network. An LCD can be programmed to be only operation when a node is operational in stand-alone mode, with a network fault.
3. Supervision of system components, wiring, initiating devices and software shall be provided by the control panel. Failure or fault of system component or wiring shall be indicated by type and location on the LCD display. Software and processor operation shall be independently monitored for failure. The system shall provide fail-safe operation, with multiple-levels of system operation.
4. Shall be capable of Speaker Volume Control. The Supervised Volume Control will allow manual volume setting for telephone paging and background music for a specific speaker or speaker zone.

5. Shall be capable of independent paging for at least (5) distinct paging zones. The five paging zones shall be as follows:
    - a. New Middle School Wing
    - b. Future
    - c. Future
    - d. Future
    - e. Future
  6. Shall be capable of secure access to the Voice Evacuation/Mass Notification panel via cell phone or other remote telephone.
- D. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, monitor, trouble and component status messages and control menu.
1. The common control switches and with corresponding LEDs provided as minimum will be; Reset Alarm Silence, Panel Silence, and Drill. It shall be able to add additional switches/LEDs as required.
  2. Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
- E. Audio One-Way Voice Communications
1. The voice communication system shall be single channel audio evacuation systems, to allow the ability to have simultaneous announcements/paging.
  2. The system custom digital voice message shall provide a minimum of 2 minutes and be created as a .wav file format.
- F. Provide an Emergency Voice Communication System with the following design features:
1. An audio control unit with Microphone for Paging.
  2. Provide 2-position switch for manually activate pre-recorded voice messages, with "Message Name" positions identified and one LED status indicators, one red. Provide minimum of 12 selector switches.
  3. Provide 2-position switch for manually activate audio paging zones with "Paging Zone Name" positions identified and one LED status indicators, one red. Provide minimum of 12 selector switches.
  4. Locate audio control unit within existing Middle School Office.
- G. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions
- H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change to alternate settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- I. Digital Alarm Communicator Transmitter: The system shall have an integrated off premise communications capability using a digital alarm communications transmitter (DACT) for sending

system events to multiple central monitoring station (CMS) receivers. The system shall provide the CMS(s) with point identification of system events using 4/2, 3/1, Contact ID or SIA DCS protocols. The dialer shall have the capability to support up to 255 individual accounts and to send account information to eight (8) different receivers, each having a primary and secondary telephone access number. System events shall be capable of being directed to one or more receivers depending on event type or location as specified by the system designed. In the event of a panel CPU failure during a fire alarm condition, the DACT degraded mode shall transmit a general fire alarm signal to the CMS.

1. Digital data transmission shall include the following (Contact ID)

- a. Address of the alarm-initiating device.
- b. Loss of ac supply or loss of power.
- c. Low battery.
- d. Abnormal test signal.
- e. Communication bus failure

- J. Secondary Power: Shall provide 24 hours supervisory and 15 minutes of alarm with batteries, automatic battery charger, and automatic transfer switch.

## 2.4 SYSTEM SMOKE DETECTORS

### A. General Requirements for System Smoke Detectors

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
7. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
8. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
9. Provide multiple levels of detection sensitivity for each sensor.
10. Device Replacement: The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced. System shall display an off-normal condition until the proper detector type has been installed or change in the application program profile has been made.

### B. Intelligent Photoelectric Detector

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
3. Primary status.
4. Device type.
5. Present average value.
6. Present sensitivity selected.
7. Sensor range (normal, dirty, etc.).

## 2.5 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
  1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

## 2.6 INTELLIGENT MODULES

- A. Intelligent Input Module. The Input Module shall provide one or two supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The single input module shall support the following circuit types:
  1. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
  2. Normally-Open Alarm Delayed Latching (Waterflow Switches)
  3. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
  4. Normally-Open Active Latching (Supervisory, Tamper Switches)
- B. Intelligent Relay Module. Provide addressable control relay circuit modules shall provide one (1) form C dry relay contacts rated at 120 VAC @ 1 amps (or as required) to control external appliances or equipment. The position of the relay contact shall be confirmed by the system firmware.

## 2.7 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
  1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
  2. The manual pull station will have an intelligent module integral of the unit.
  3. Station Reset: key operated switch shall match the control panel key.
  4. Manual pull stations that initiated an alarm condition by opening the unit are not acceptable.

- B. Manual Blue – LOCK DOWN station: Station shall be finished in Blue body with white lettering “LOCK-DOWN” and shall have red momentary illuminated mushroom button. Unit shall have clear cover to prevent accidental activation.
- C. Manual Yellow – SEVERE WEATHER station: Station shall be finished in Yellow body with white lettering “SEVERE WEATHER” and shall have red momentary illuminated mushroom button. Unit shall have clear cover to prevent accidental activation.

## 2.8 NOTIFICATION APPLIANCES

- A. All appliances shall be compatible with Fire Alarm Control Panel and application of the appliances shall be done in accordance with the manufacturers’ instructions.
- B. All appliances shall be wall or ceiling mounted white body and shall be UL listed Fire Protective Service.
- C. Notification Appliances – Visual
  - 1. Provide clear lens strobes that provide a smooth light distribution pattern field selectable candela 15 cd, 30 cd, 75 cd, and 110 cd flash output rating, UL1971 listed with in-out screw terminals shall be provided for wiring. The strobe (15, 30, 75, 110) candela rating shall be view from the side window to verify the setting. All strobes shall be synchronization to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules. The strobes shall mount to one-gang electrical box.
  - 2. High candela clear lens strobes that provide field selectable candela 95cd, 115cd, 150cd and 177cd flash output rating, UL1971 listed with in-out screw terminals shall be provided for wiring.
- D. Notification Appliance – High Fidelity Speaker
  - 1. Ceiling mounted, 2’x2’ ceiling tile replacement lay-in speak. UL listed as Fire Signaling Device loudspeaker. Loudspeaker cone shall be constructed of molded paper fiber with approved fire retardant treatment.
  - 2. The rear of the speakers shall be completely sealed protecting the cone during and after installation. Speakers shall provide at least four power taps (1/4w, 1w, 2w, and 4w) for use with 70V systems.
  - 3. High Fidelity Speaker listed frequency response of 60 to 12,000 Hz
- E. Trumpet Type Loudspeaker
  - 1. Provide a trumpet speaker at the locations shown on the drawings. The trumpet speaker shall be able to operate within any ambient temperature environment ranging from 66°C (150°F) to -35°C (-30°F), with weather-resistant unit shall be constructed of heavy-gauge treat aluminum. Model shall be a double re-entrant type with 15 watts RMS audio power rating compression driver producing a UL-rated sound pressure level of 102dB measured at 15 watts, 10ft. (3dB increment rating) within a frequency range of 400 Hz to 4 kHz. Impedance shall be 8 ohms and sound dispersion 70°. Power taps shall be available at .9, 1.8, 3.8, 7.5, 15 watts for 70V line. Trumpet loudspeaker assembly shall be furnished with mounting bracket allowing adjustment on either a vertical or horizontal plane with a single locking pin and including provisions for mounting, banding, or strapping. Wiring terminals for amplifier output shall be fully enclosed and a vandal-resistant adapter cover shall provide connection facilities for cable or conduit. Unit shall be finished in either gray

baked epoxy or red baked epoxy. Color shall be verified with Owner prior to ordering and installation.

## 2.9 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
  - 1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
  - 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
  - 3. Rating: 120-V ac, 24-V ac or dc.
- B. Coordinate rough-in location with door hardware provided. Location of door holders shown on Drawings should be adjusted as required.

## 2.10 WIRE AND CABLE

- A. General: Cable jacket color shall be red.
- B. Signaling Line Circuits – Network Data: Twisted pair, not less than No. 18 AWG or as recommended by the manufacturer.
- C. Signaling Line Circuits – Intelligent Loop: Non-Twisted pair, not less than No. 16 AWG or as recommended by the manufacturer.
  - 1. Circuit Integrity Cable: Provide as required to meet NFPA or Local Code requirements.
  - 2. CI Cable shall meet article 760, power limited fire alarm service.
- D. Notification Appliance Circuits –
  - 1. Audio: Twisted pair, not less than No. 16 AWG or as recommended by the manufacturer.
  - 2. Visual. Non-Twisted pair, not less than No. 12 AWG or as recommended by the manufacturer.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 and NEC Article 760 for installation of fire-alarm equipment.
- B. Smoke- or Heat-Detector Spacing:
  - 1. HVAC: Locate detectors not closer than 5 feet from air-supply diffuser or return-air opening.
  - 2. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
- C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

- D. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- E. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- F. Annunciator: Install with top of panel not more than 56 inches above the finished floor.

### 3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 8 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Alarm-initiating connection to activate emergency lighting control.
  - 2. Supervisory connections at valve supervisory switches.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.

- a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
  - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- 3.6 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111